

Figure 1

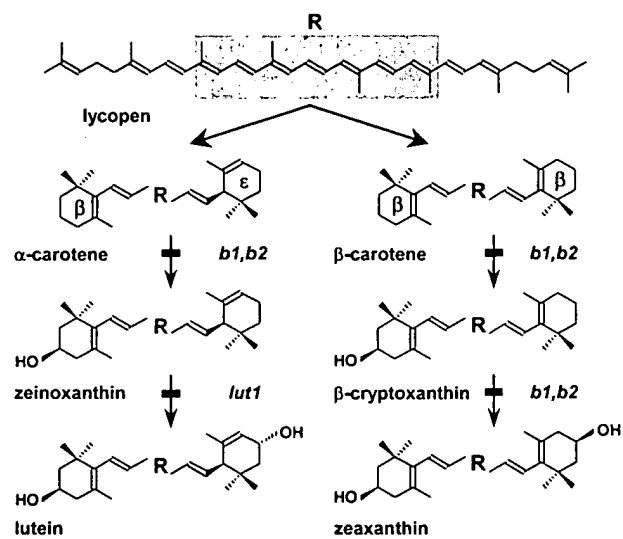


Figure 2

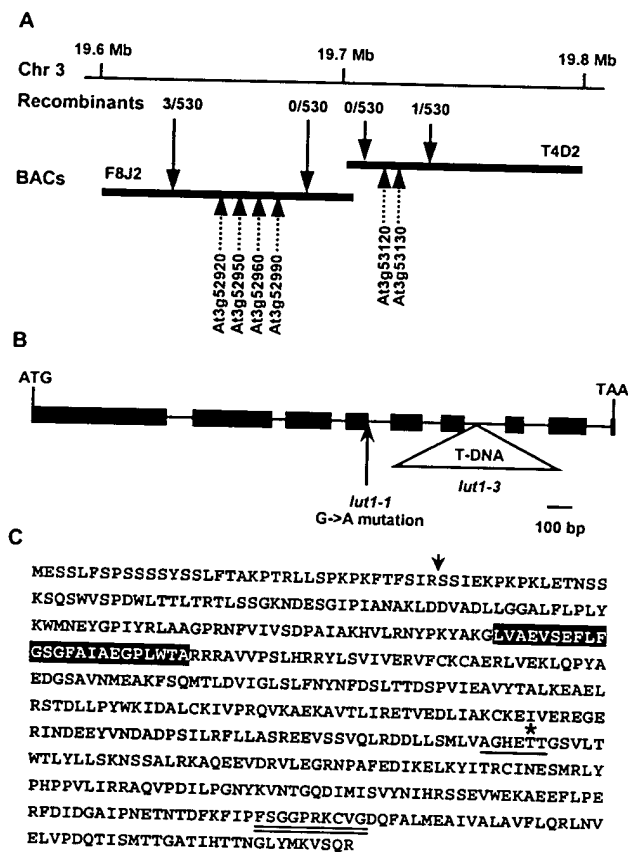


Figure 3

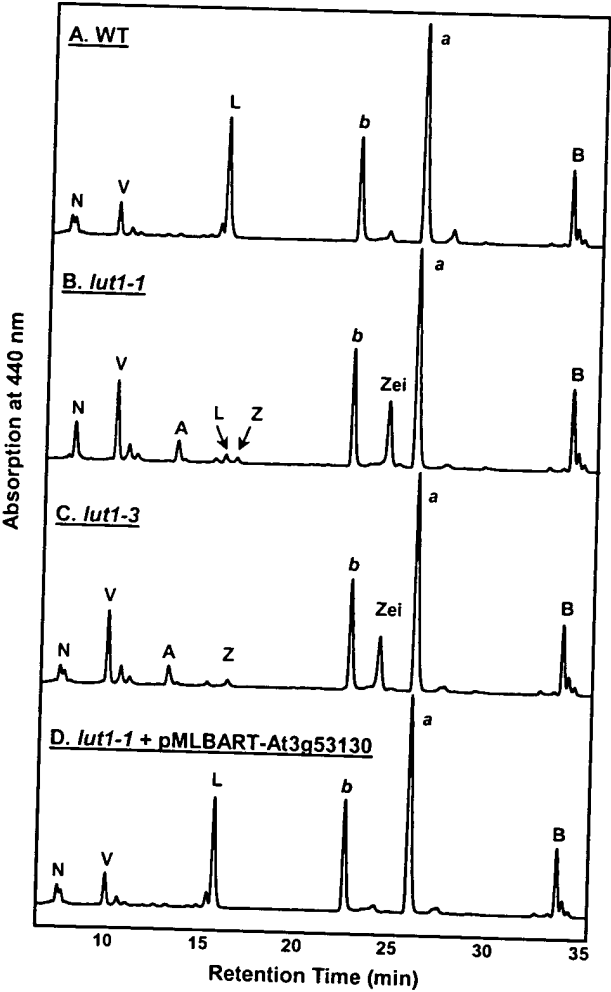


Figure 4

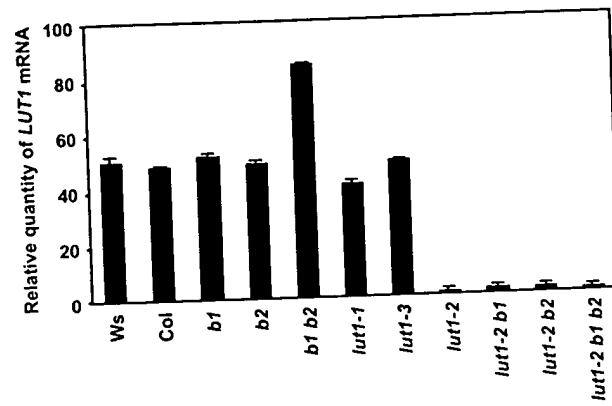


Figure 5

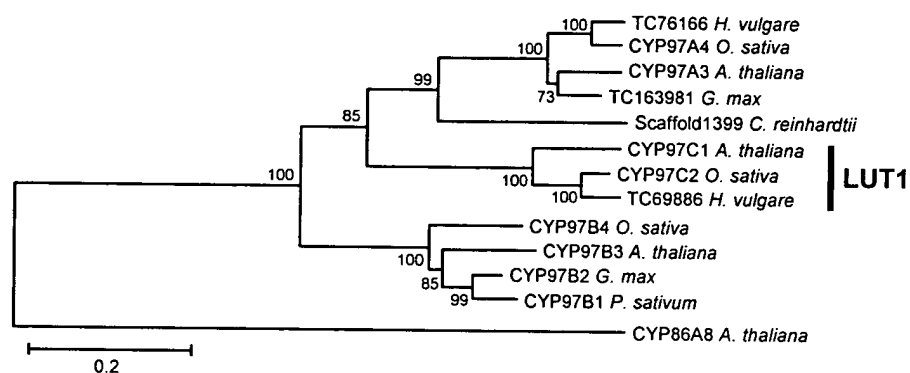


Figure 6

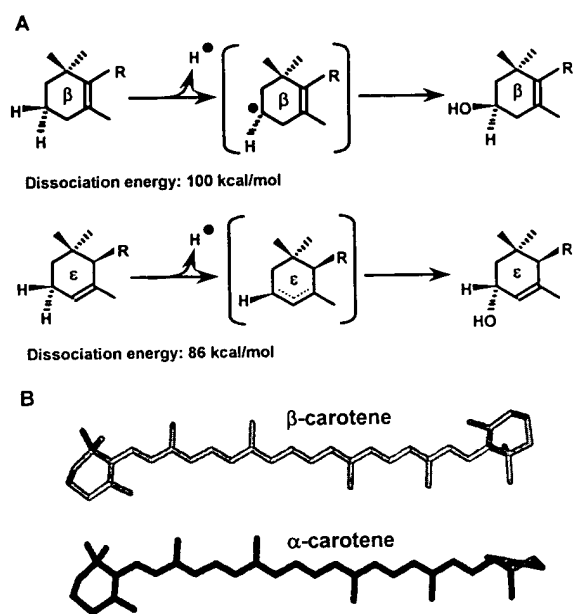


Figure 7

CYP97A3(Arabidopsis) single knockout mutant (SALK_116660)

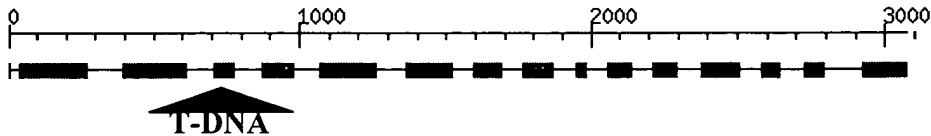
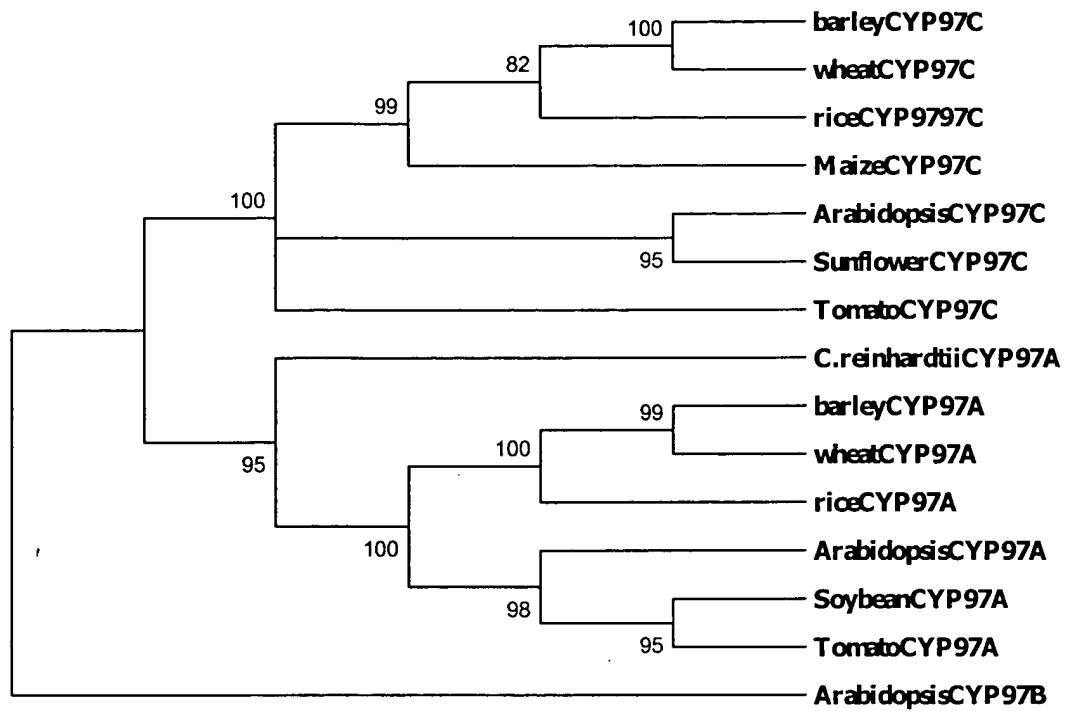


Figure 8



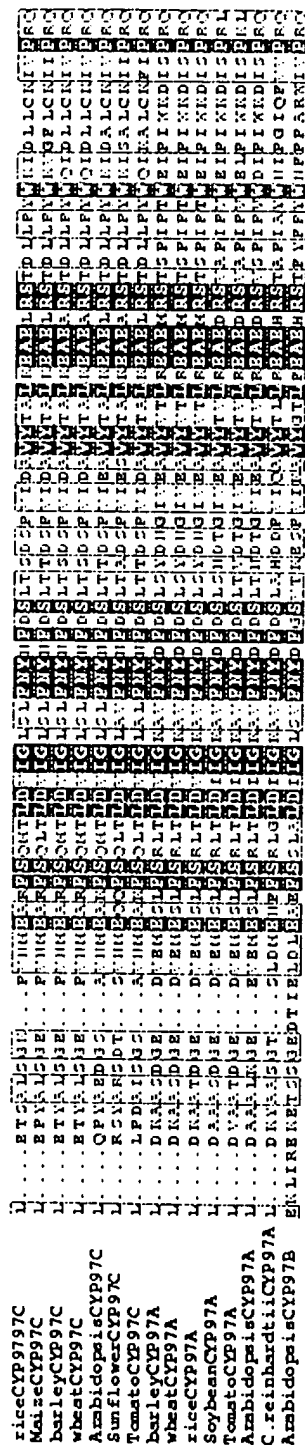
Phylogenetic tree
(Neighbor-joining tree with p-distance, Pairwise deletion method was used. Arabidopsis CYP97B is an outgroup.)

Figure 9

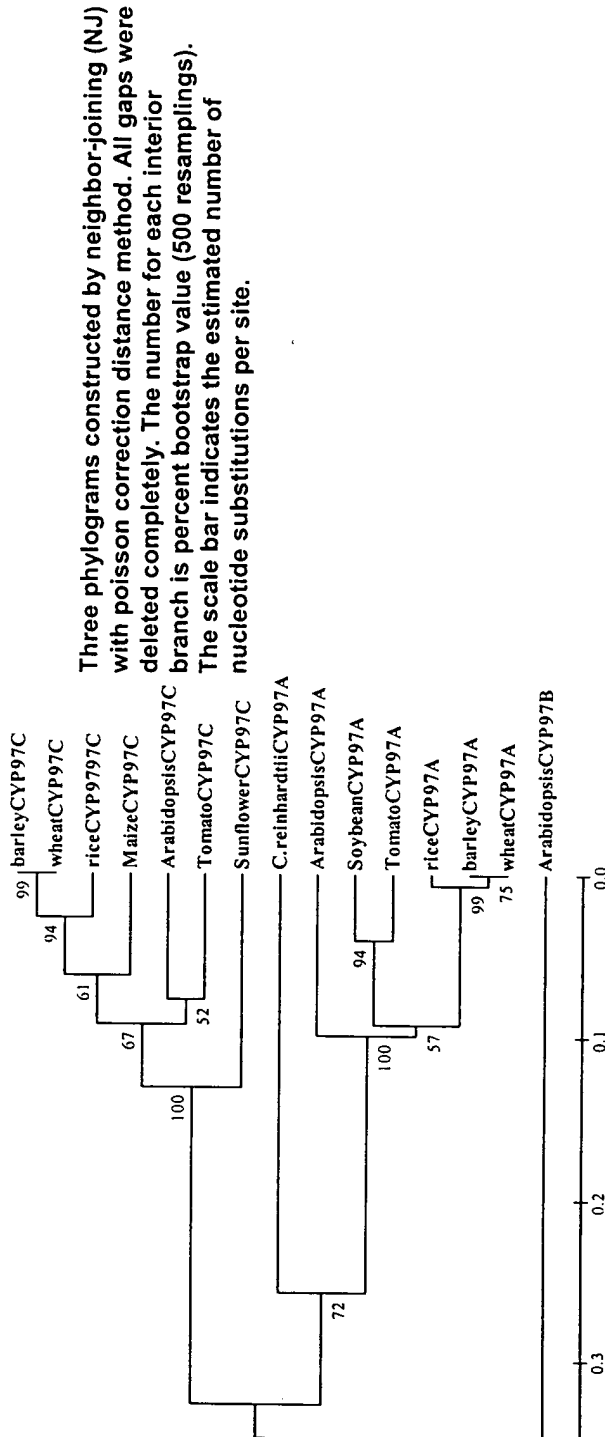
Amino acid similarity

	CYP97A	CYP97C
Arabidopsis	100%	100%
Rice	405/544 (74%),	385/488 (78%),
Barley	374/481 (77%),	395/524 (75%),
G. max (Soybean)	343/410 (83%)	not included
Wheat	243/328 (74%)	254/350 (72%),
tomato	441/546 (80%),	226/279 (81%),
sunflower	not included	167/202 (82%),
maize	not included	145/177 (81%),
Chlamydomonas	223/365 (61%),	not included

Figure 10

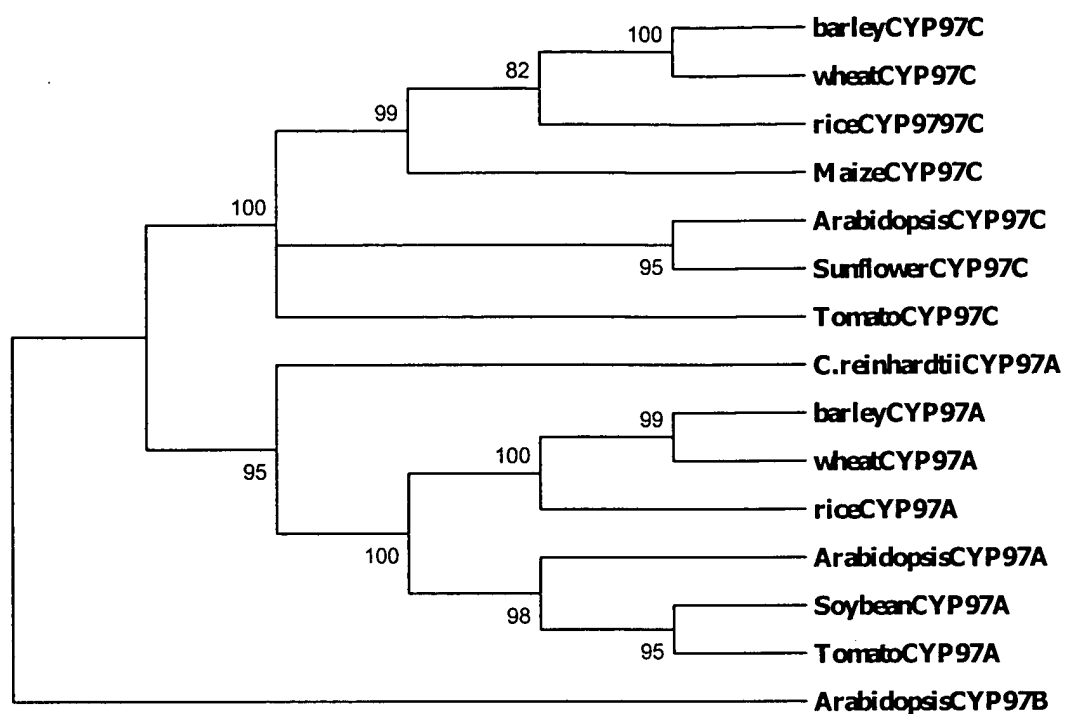


These amino acids were used for constructing phylogenetic trees



Three phylogenetic trees constructed by neighbor-joining (NJ) with poisson correction distance method. All gaps were deleted completely. The number for each interior branch is percent bootstrap value (500 resamplings). The scale bar indicates the estimated number of nucleotide substitutions per site.

Figure 11



Phylogenetic tree

(Neighbor-joining tree with p-distance, Pairwise deletion method was used. Arabidopsis CYP97B is an outgroup.)

Figure 12

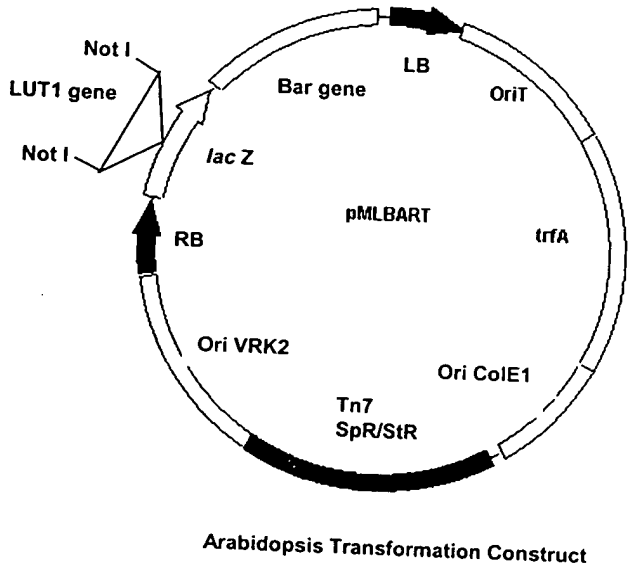
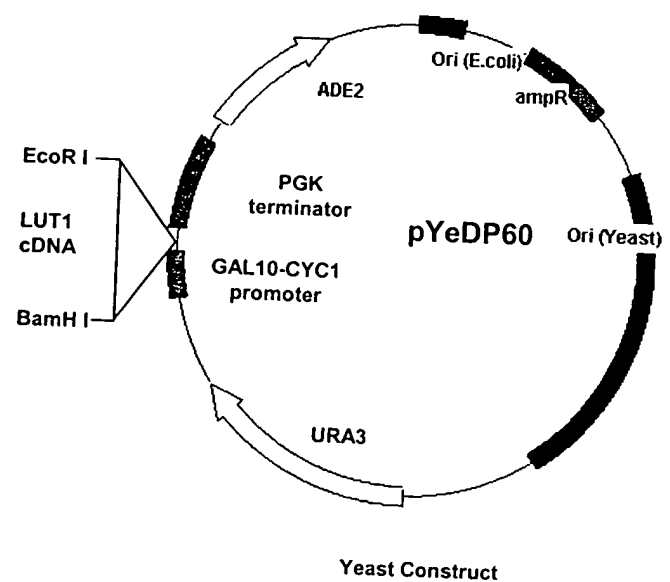


Figure 13

Table 1. β -Xanthophyll production and β -ring hydroxylation in leaf tissue of wild type and carotenoid hydroxylase mutants^{*}

Genotype	β -Xanthophylls [†]	Hydroxylated β -rings [‡]
Ws	54.0 \pm 2.7 [§]	48.5 \pm 1.0 ^a
Col	60.7 \pm 7.6 ^a	48.7 \pm 0.9 ^a
<i>b1 b2</i>	20.5 \pm 4.8 ^b	40.2 \pm 1.4 ^b
<i>lut1-2 b1 b2</i>	26.5 \pm 3.4 ^b	33.6 \pm 2.4 ^c
<i>lut1-3 b1 b2</i>	28.3 \pm 4.6 ^b	31.1 \pm 1.2 ^c

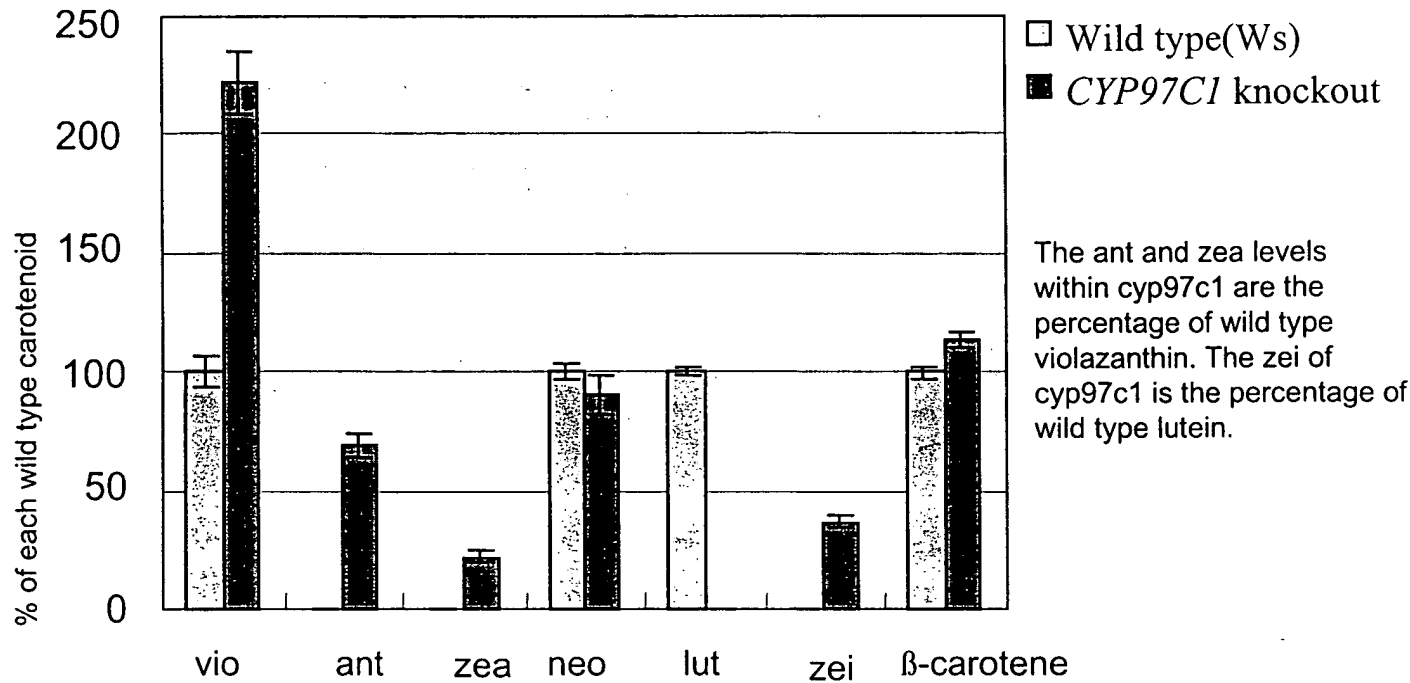
^{*} Total carotenoids were extracted from five-week-old plants and quantified by HPLC as previously described (Tian et al., 2003).

[†] β -xanthophylls are the sum of zeaxanthin, antheraxanthin, violaxanthin, and neoxanthin as mmol pigment/ mol chlorophyll *a* + *b*.

[‡] Data are given as percentage of total ring hydroxylation.

[§] All values are means \pm SD (n = 6). Values marked with the same letters are not significantly different from each other within a column (Student's *t* test, *P* > 0.05).

Figure 14

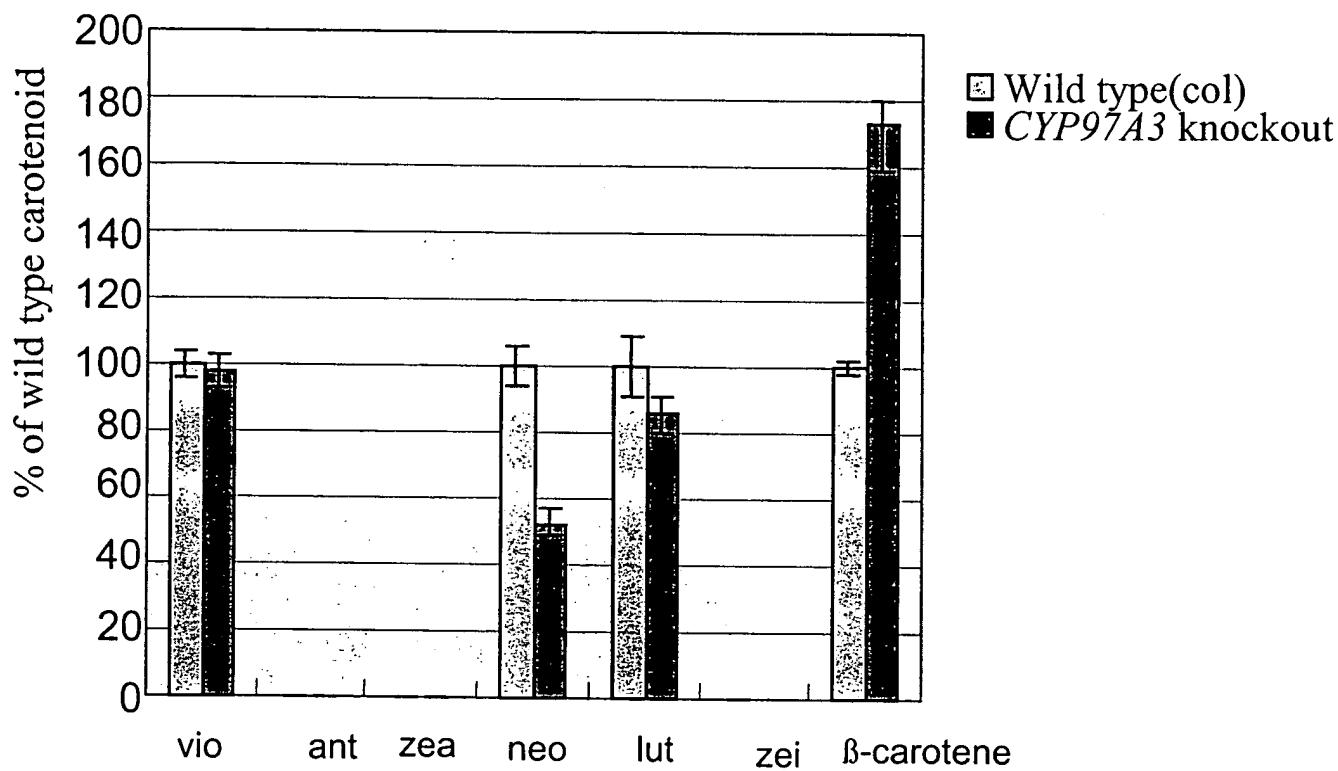


Neoxanthin level is not significantly different between wild type and *CYP97C1* knockout ($p > 0.05$)

Student t-test (two-tails)

	vio	ant	zea	neo	lut	zei	β- carotene
Ws/ <i>cyp97c1</i>	0.007098	0.001631	0.00604	0.111459	9.22469E- 05	0.00153	0.04776516

Figure 15

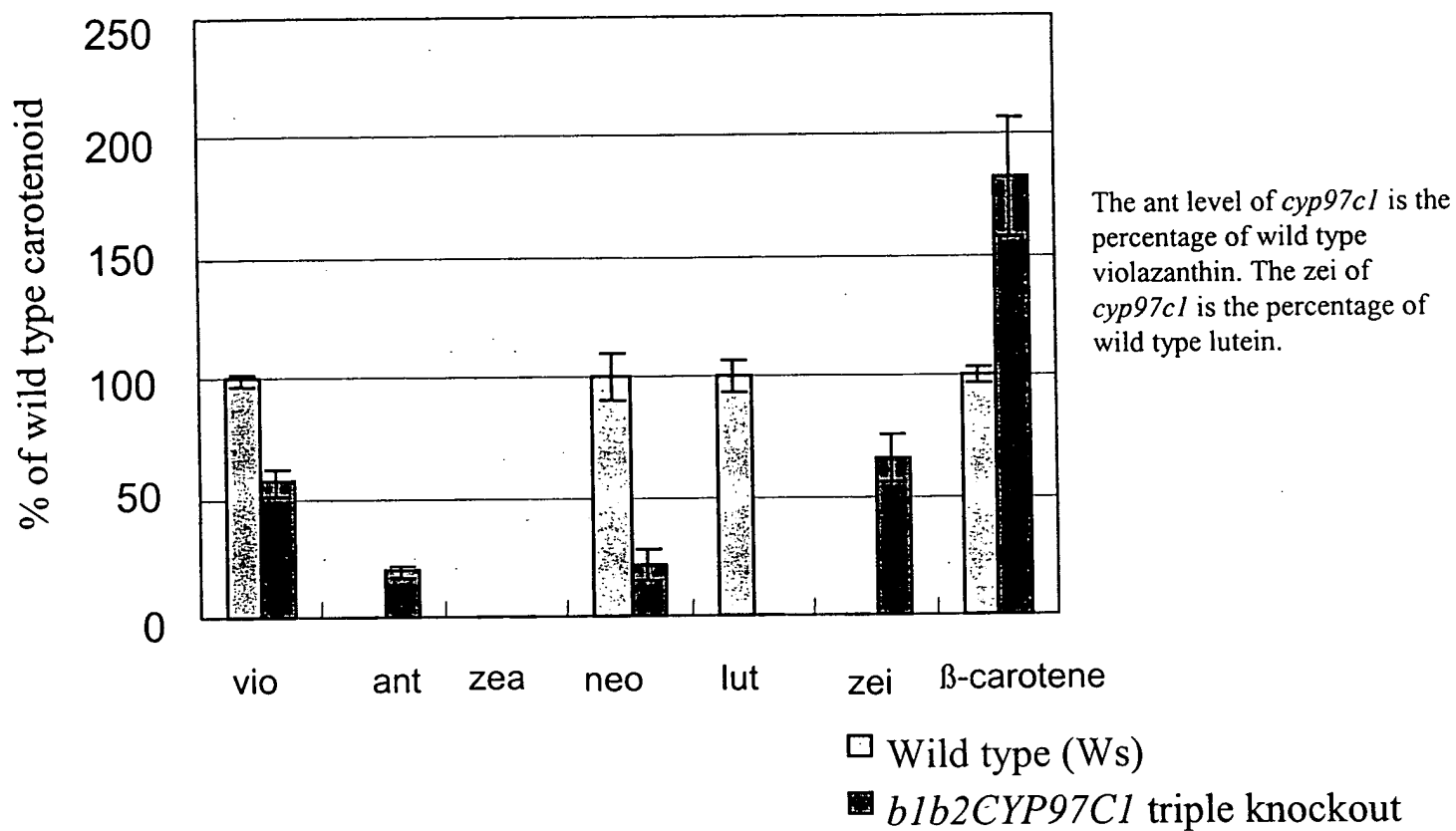


Student t-test (two-tails)

	vio	ant	zea	neo	lut	zei	β-carotene
Col/cyp97a3	0.63368	n/a	n/a	0.01116	0.03972875	n/a	0.009973

violaxanthin level is not significantly different between wild type and *CYP97C1* knockout ($p>0.05$)

Figure 16



Student t-test (two-tails)

	vio	ant	zea	neo	lut	zei	β-carotene
ws/b1b2cyp97c1	0.0076	0.0041	n/a	0.0141	0.001563	0.0068	0.032631

Figure 17

	vio/(chia+b)	ant/(chia+b)	zea/(chia+b)	neo/(chia+b)	lut/(chia+b)	zei/(a+b)	β -car/(chia+b)
wild type(Ws)	100	0	0	100	100	0	100
STDEV, wild type(Ws)	6.1	0	0	3.17	1.66	0	2.43
<i>CYP97C1</i> knockout	221.8388	69.77	21.94	89.97	0	36.82	113.17
STDEV, <i>CYP97C1</i> knockout	12.72	4.89	2.97	8.14	0	2.49	2.96
wild type(col)	100	0	0	100	100	0	100
STDEV, wild type (col)	3.78	0	0	5.83	8.67	0	2.34
<i>CYP97A3</i> knockout	98.12	0	0	52	86.2	0	173.49
STDEV, <i>CYP97A3</i> knockout (col)	5.05	0	0	3.03	6.13	0	14.42
wild type(Ws)	100	0	0	100	100	0	100
STDEV, wild type(Ws)	2.36	0	0	9.83	6.86	0	3.18
<i>b1b2CYP97C1</i> triple knockout	57.15	19.36	0	21.17	0	65.62	182.97
STDEV, <i>b1b2CYP97C1</i> triple knocko	5.39	2.14	0	7.16	0	9.43	24.7

Fig. 18

SEQ ID NO: 1: CYP97C *Arabidopsis thaliana*:
LQPYAEDGSAVNMEAKFSQMTLDVIGLSLFNYNFDSLTTDSPVIEAVYTALKEAELRSTDLLPYWKIDALC
KIVPRQ

SEQ ID NO: 2: CYP97A *Arabidopsis thaliana*:
LDAAALKGEEVEMESLFSRLTLDIIGKAVFNFDLSLTNDTGVIIEAVYTVLREAEDRSVSPVWDIPIWK
DISPRQ

SEQ ID NO: 3: CYP97B *Arabidopsis thaliana*:
EKLIREKETSSGEDTIELDLAEFSSLALDIIGLSVFNYDFGSVTKESPVIAVYGTLFEAHRSTFYFPY
WNFPPARWIVPRQ

Figure 19a

SEQ ID NO: 4: LUT1 *Arabidopsis thaliana* (CYP97C1):

MESSLFSPPSSSSSYSSLFTAKPTRLLSPKPKFTFSIRSSIEKPKPKLETNSSKSQSWVSPDWLTTLTRLSS
GKNDESGIPIANAKLDDVADLLGGALFLPLYKWMNEYGPIYRLAAGPRNFVIVSDPAIAKHVLRNYPKYAK
GLVAEVSEFLFGSGFAIAEGPLWTARRRAVVP SLHRRYLSVIVERVFCKCAERLVEKLQPYAEDGSAVNME
AKFSQMTLDVIGLSLNFYNFDSLTTDSPVIEAVYTALKEAELRSTDLLPYWKIDALCKIVPRQVKAEKAVT
LIRETVEDLIAKCKEIVEREGEINDEEYVNDADPSILRFLLASREEVSSVQLRDDLLSMLVAGHETTGSV
LTWTLYLLSKNSSLARKAQEEVDRVLEGRNPAFEDIKELKYITRCINESMRLYPHPVLIIRRAQVPDILPG
NYKVNTGQDIMISVYNIHRSSEVWEKAEFLPERFDIDGAIPNETNTDFKFIPFSGGPRKCVGDQFALMEA
IVALAVFLQRLNVELVPDQTISM TGTGATIHTTNGLYMKVSQR

SEQ ID NO: 5: LUT1 *Arabidopsis thaliana* (CYP97C1):

atggagctcttcactcttttctccatcttctcttcttactcttctcttcttactgcaaaacctacgcgtct
tttatcaccaaaacccaaattcacattctccatcagatcctccattgagaaacccaaacccaaactcgaga
ccaattcatcgaaatcccaatcatgggtcagtcgccgattggctcacaacactcactcgtaacctttctctca
ggaaaaaacgacgagtcaggtataccaatcgcaacgcgaagctcgacgatgtcgctgatctcctcggagg
tgctctcttcttacctctctacaaatggatgaatgagtagcgaccatttaccgtctcgctgctggtcctc
gtaatttcgtaattgtgagcgaccagcgatagctaaacatgttttgaggaattatccaaagtacgctaaa
ggcttagtcgctgaagtctctgaatttctatttgggttcgggttctcgctatcgctgaaggacctcttggac
agtaatttcctctcctctctcaatttgaagtttgggaattgtggaagtaattgtgtgactgtcttgt
atgataagtaactctaattttagggtttagattccaatcttctctattgggcttagctgaagctctgattt
ttacatagggcgaggcgtagagcggtggttccatcgcttcacaggaggtatttgtctgtgattgtggagaga
gtattctgcaaatgtgcagagaggcttgttgagaagttgcagccttatgcagaagacggaagtgtgtgaa
tatggaagcgaagttctctcagatgacacttgatgtcattgggttgtctcttttaactacaatttcgatt
ctttgactactgatagtcctgtcattgaagctgtttacactgctcttaagaagctgagcttcgttctact
gatcttctgccatattggaaggcaagtttctgtgtttttctgtggttgttgattgtgtggaacaattg
gattcttgttaattgagagggttgggtgttttttccagatcgatgcattgtgtaagatagtcgccgagaca
ggtgaaagctgaaaaggctgtaactttgataagggaaactgttgaagacctatttgctaagtgtaaagaaa
ttgtcgaaagagaaggcgaaagaatcaatgatgaggagtagtgaatgatgtgacccaagtagtctgcgt
ttcttgccttgaagcagagaagagggtttaaacttttcttcttaagtttataagcaaatttggcctttcatt
atcgcataatcgaagctgatgttgcattgtgagggtttccaggtagtcaagtgtagtgcagttacgggtagct
tctctcaatgctcgtagcgggtcatgaaaccactggatctgtcctcacttggacactttatctcctaagta
aggtagcttaattgtatcttctactttgctatgctagagaatttacttggatgggagcttctctgttctcat
ttacctcttcaattctctatgttcatagaactcatctgcattaaaggaaagcacaagaagaagtagacaga
gtgttagaaggaagaaacccggctttcgaggatataaaggagttgaagtacatcactcgttgtataaacga
gtcaatgcgtctctatcctcatcctcctgtaagcaatcaagctcatctctctaattattcatgaactaaat
tttctgattgatttgtttcctggttaggtcttgataagaagagctcaagttcctgacattcttctcgggaac
tataaggtcaataccggacaagacattatgatttcagctctataacatccatcgcttcttccgaggtagctt
ctcttcttctctcgtccatagtagtataacataggggagcctaactcttctcttcaatgatcttctgtgtggtt
cggatatctaaccggagtgagacattcctagtagtattacattcatgccacatttcttatgtgttgttgtt
ttattccaaaggtatgggaaaaagctgaggaatttctgcctgaacgattcgacatagatggcgcaatccct
aacgaaacaaacactgatttcaagtaaaactcagtagaacacatcttttgacacaaactactgaatcaagat
tagtggttttgattaggaattttaaagatgattttcttttttaccagattcatcccatcagtgagggg
cctagaaaatgtgtaggcgatcagtttgcattgatggaggcaattgtggcactcgcggtgtttcttcagcg
gttaaagcttgagctggttctgatcagaccattagcatgaccacaggagcaaccatacacaccaccaatg
tatgccaatgttctcacactcgagagattaatgagagtgctgttttgtttagaatgattccaatttctct
aatgctgatattttcaatttcagggtatgtatatgaagtgagccaaaggtaa

SEQ ID NO: 6: At3g53130 *Arabidopsis thaliana* (CYP97C1):

Cctgggtcaagagagagcagaaattgctgatacgcatctttgtcagagagaagcttctcgtagttcatccag
ctacagaaaagtatacactattcaaaaagaagacatacaaaaaaacgcacactcgagagaaggataacaa
acaaacaaacaaaaagagcaaaccttttgtctttcaagaagacgataatgccagctgcttcacccggtgat
acttgtgctgaaatctgacctgaactttgaggccgggatgagcttggcgagctaactaaagaaggcgagta
ccatggcgactgtgaagaagcttctgaggacgagattgcccttgttgttgggtcttttgatcccttcaag
tacacaacaaaaaaagaacatcatcaactaactatctcagcttccaagttaatataatacatcacctca
taaacttgaaaggtgcatttatacagcacatcattgtaaacctaataatcagtaactatgaaccctaataca

Figure 19b

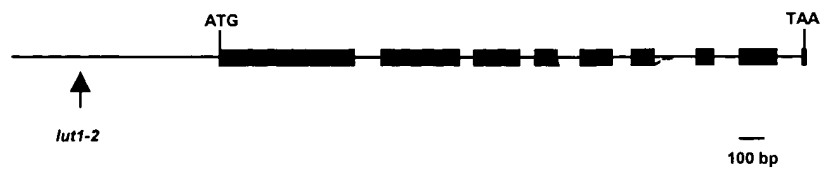
gtagctgagcaaaatctacacttgtcaattcacctcaaaaacctcaaatatatcattatagctcaacaaac
tacacaacaacaagatttcttaatcgctaacagacctaatgtctggatcacgcaatttcatcaataacat
atgaatcagatggcaaaaaattcgcaaaatcataccagaaattgaacatcgtttctagaattcgccgacta
acgaaaggaattgactttttcttgttctcttgtacttcttcttctaccagatcgacaaaatttaacaaact
ttacagaaacagagtttacagagtttcaaagaaaattcgatcttctctgtttcgtttcagattttgtact
tgcttttaaaaggcccaaatacagaggaggcccatattaagttttgattaacaaaacgtagtcgtttatgc
atcgctcgctcttatccacgcgtaacgggttcgctgttctacacagagtcacaaatatttctgcacggaagcttc
gaaaagaggtcatcaatggagttctcactcttttctccatcttctcttactcttctctctcactgc
aaaacctacgcgtcttttatcaccaaaacccaaattcacattctccatcagatccctcattgagaaaccca
aaccctaaactcgagaccaattcatcgaaatcccaatcatgggtcagtcgagattgggtcacacacactcact
cgtacccttttctcaggaaaaacgacgagtcaggtataccaatcgcgaaacgcaagctcgacgatgtcgc
tgatctcctcggaggtgctctcttcttacctctctacaaatggatgaatgagtagcgaccatttaccgtc
tcgctgctgggtcctcgtaatttcgtaattgtgagcgacccagcgatagctaaacatgttttgaggaattat
ccaaagtagcgtaaaggcttagtcgctgaagtctctgaatttctatttgggttcgggttcgctatcgctga
aggacctctttggacagtaatttcatctcctcctatctcaatttgaagttttggaattgtggaagta
gtgtgactgtcttgtatgataagtaactctaattttaggggttagattccaatcttctctattgggcttag
ctgaagtctgattttttacataggcgaggcgtagagcggtgggtccatcgcttcacaggaggtatttgtct
gtgattgtggagagagtagtattctgcaaatgtgcagagaggcttgttgagaagttgcagccttatgcagaaga
cggaagtgtgtgaatatggaagcgaagttctctcagatgacacttgatgtcattgggtgtctcttttta
actacaatttcgattctttgactactgatagtcctgtcattgaagctgtttacactgctcttaagaagct
gagcttcgttctactgatcttctgccatattggaaggcaagtttctgtgtttttctgtgggttgttgat
tgtgtggaacaattggattcttgttaattgagaggggttgggtgttttttcagatcgatgcatttgtgtaa
gatagtcgagacaggtgaaagctgaaaaggctgtaactttgataagggaactgttgaaagacctatttg
ctaagtgtaaagaaattgtcgaaagagaaggcgaaagaatcaatgatgaggagtagttaaagtagctgac
ccaagtatcctgctgtttcttgccttgcaagcagagaagaggtttaaactttttccttaagtttataagcaa
atttggcctttcattatcgcataatcgaaagctgatgttgcatgtgaggggtttcagggtatcaagtggtgca
gttacgggtagatcttctcctcaatgctcgtagcgggtcatgaaaccactggatctgtcctcacttggacac
ttatctcctaagtagtaccttaattgtatcttctacttctctatgctagagaatttacttggatgggag
cttctctgttctcattttacctcttcaaattctctatgttcatagaactcatctgcattaaaggaaacacaa
gaagaagtagacagagtggttagaagggaagaaacccggctttcgaggatataaaggagttgaagtacatcac
tcgttgtataaaacgagtcgaatgcgtctctatcctcatcctcctgtaagcaatcaagctcatctctctaatt
attcatgaactaaattttctgattgatttgtttcctggtaggtcttgataagaagagctcaagttcctgac
attcttctcctgggaactataagggtcaataccgggacaagacattatgatttcagtcctataacatccatcggtc
ttccgaggtacagttctcttcttctctcgtccatagtataacataggggagcctaattccttctcttcaat
gatctttgtgtgtgttcggatatctaaccggagtggaacattcctagtagttacattcatgccacatttctta
tgtgtttgtgtgtttgttattccaaagggtatgggaaaaagctgaggaatttctgcctgaacgattcgacata
gatggcgcaatccctaacgaaacaaacactgatttcaagtaaaactcagtagaacacatcttttgacacaaa
ctactgaatcaagattagtggttttgattaggggaattttaaagatgattttcttttttaccagattcatc
ccattcagtgaggggcctagaaaatgtgtaggcgatcagtttgcatgtgatggaggcaatttgtggcactcgc
gggtgtttcttcagcggttaaactgtgagctgggttctgatcagaccattagcatgaccacaggagcaacca
tacacaccaccaatgtatgccaatgttctcacactcgagagattaatgagagtgctgttttgtttagaat
gattccaatttctctaattgctgatattttcaatttcagggttgatatgaaggtagagccaaaggtaaaaa
ccagaatttatgttttcatgataattgattgggtgtgaatggacttgtttcatagtactcttgagaaataac
cacaaaaaatgaattatggaaaatagttgtaccatcggaatgtgaatttgaacagtgagatgctagta
ccattaaagtttggtaattgtgttatcatttcaaacttccatacagcttgtgtttgttctccattt
ttcagtaattacgaaaatcaaaattttatttttttgaatttctaataatagactaagggtctaagaacca
tccattccatattggaccacacgtaacattaaccttaaaaaccatataaaaaccatataaaaaccaatactag
tgggttctatagcgatgtgtagtttcttctcacgtacgaggaagattaaaaaaaatggagaacgaaagct
cagagagtagaaacagagctcgtcttgccattatggagcttgctaacatgattagcggttcccatgtctctc
aatgccgctgctgactaggcattgccgacgccatttggaaacggcgagccaattctcctctctctgcgc
cgagatcctcctcgctccacctaccatctcacactaccattgggtggcgaccccgagaatcttcagcgta
tacttcggatgctcaccagctacgggtgtcttctccgaacaccttgttggatc

Figure 20

SEQ ID NO: 7: mutant LUT1-1 *Arabidopsis thaliana* (*lut1-1*):
atggagtccttcactcttttctccatcttctcttcttactcttctctcttcttactgcaaaacctacgcgtct
tttatcaccaaaacccaaattcacattctccatcagatcctccattgagaaacccaaacccaaactcgaga
ccaattcatcgaaatcccaatcatgggtcagtcocgattgggtcacaacactcactcgtaaccttttctca
ggaaaaaacgacgagtcaggtataccaatcgcgaaacggaagctcgacgatgtcgctgatctcctcggagg
tgctctcttcttacctctctacaaatggatgaatgagtaacgacccatttaccgtctcgctgctggctctc
gtaatttcgtaattgtgagcgacccagcgatagctaaacatgttttgaggaattatccaaagtacgctaaa
ggcttagtcgctgaagtcctctgaatttctatttggttcgggtttcgctatcgctgaaggacctctttggac
agtaatttcactctcctcctatctcaattttgaagtttttggaattgtggaagtaatgtgtgactgtcttgt
atgataagtaactctaatttttagggtttagattccaatcttctctatttggttagctgaagtcgtatgtt
ttacataggcgaggcgtagagcggtgggtccatcgcttcacaggaggtatttgtctgtgattgtggagaga
gtattctgcaaatgtgcagagaggcttggtgagaagttgcagccttatgcagaagacggaagtcgtgtgaa
tatggaagcgaagttctctcagatgacacttgatgtcattgggttgctctcttttaactacaatttcgatt
ctttgactactgatagtcctgtcattgaagctgtttacactgctcttaagaagctgagcttcgttctact
gatcttctgccatattggaaggcaagtttctgtgtttttctgtgtgtgtgtgattgtgtggaacaattg
gattcttggttaattgagaggggttggttggttttttcagatcgatgcattgtgtaagatagtcggagaca
gggtgaaagctgaaaaggctgtaactttgataagggaaactgttgaaagacctattgctaagtgtaaagaaa
ttgtcgaaagagaaggcgaaagaatcaatgatgaggagatgtaaatgatgtgacccaagtatcctgcgt
ttcttgcttgcaagcagagaagagggttaaactttttccttaagtttataagcaaatttggtcttctcatt
atcgcataatcgaagctgatgttgcttgagggttttcaggtatcaagtggtgcagttacgggatgatct
tctctcaatgctcgtagcgggtcatgaaaccactggatctgtcctcacttggaacctttatctcctaagta
aga²taccttaatgtatcttctactttgctatgctagagaatttacttggatgggagcttctctgttctcat
ttacctcttcaaattctctatgttcatagaactcatctgcattaaggaaagcacaagaagaagtagacaga
gtgttagaaggaagaaacccggctttcgaggatataaaggagttgaagtacatcactcgttgtataaacga
gtcaatgcgtctctatcctcatcctcctgtaagcaatcaagctcatctctctaattattcatgaactaaat
tttctgattgattgtttcctggtaggtcttgataagaagagctcaagttcctgacattcttctcgggaac
tataaggctcaataccggacaagacattatgatttcagtcctataacatccatcgttcttccgagggtacagtt
ctcttcttctctcgtccatagtataacataggggagcctaactcttctcttcaatgatctttgtgtggtt
cggatatctaaccggagtggaacttctagtattacattcatgccacatttcttatgtgtttgtgtgttg
ttattccaaagggtatgggaaaaagctgaggaatttctgcctgaacgattcgacatagatggcgcaatccct
aacgaaacaaacactgatttcaagtaaacctcagtagaacacatcttttgacacaaactactgaatcaagat
tagtgggttttgattaggggaattttaaagatgattttcttttttaccagattcatccattcagtgagggg
cctagaaaatgtgtaggcgatcagtttgcttgatggaggcaattgtggcactcgcggtgtttcttcagcg
gttaaagcttgagctggttctgatcagaccattagcatgaccacaggagcaaccatacacaccaccaatg
tatgccaatgttctcacactcgagagattaatgagagtgctgttttggttagaatgattccaatttctct
aatgctgatattttcaatttcagggttgatatgaagggtgagccaaaggtaa

Figure 21

SEQ ID NO: 8: LUT1-2 mutant *Arabidopsis thaliana* (*lut1-2*):



SEQ ID NO: 9: mutant *Arabidopsis thaliana* LUT1-3 (*lut1-3*)

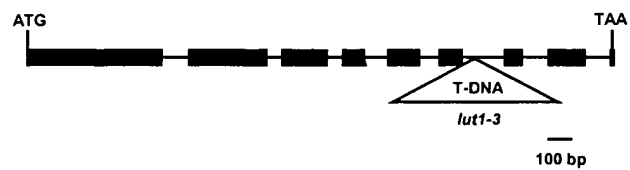


Figure 22

SEQ ID NO: 10: conserved transmembrane domain:
LVAEVSEFLFGSGFAIAEGPLWTA

SEQ ID NO: 11: conserved an N-terminal transit peptide for
chloroplast-targeting: **MESSLFSPSSSSSYSSLFTAKPTRLLSPKPKFTFSIR**

SEQ ID NO: 12: conserved consensus motif of cytochrome P450
monooxygenase molecular oxygen binding pocket: (A/G)GX(D/E)T(T/S)

SEQ ID NO: 13: conserved sequence of cytochrome P450 monooxygenase
molecular oxygen binding pocket in LUT1 *Arabidopsis thaliana*: AGHETT

SEQ ID NO: 14: conserved consensus cysteine motif in p450
monooxygenase enzymes: **FXXGXXXCXG**

SEQ ID NO: 15: conserved cysteine sequence in LUT1 *Arabidopsis*
thaliana: **FSGGPRKCVG**

Fig. 23

SEQ ID NO: 16: rice CYP97C2 *Oryza sativa*:

MAAAAAAACPVPFLCPPPPPLVSPRLRRGHVRLRLRPPRSSGGGGGGGAGGDEPPITTSWVSPDWLTALSR
SVATRLGGGDDSGIPVASAKLDDVRLDGLLGGALFLPLFKWFREEGPVYRLAAGPRDLVVVSDPAVARHVLRGY
GSRYEKGLVAEVSEFLFGSGFAIAEGALWTVRRRSVVPVSLHKRFLSMVDRVFCCKAERLVEKLETSALSGK
PVNMEARFSQMTLDVIGLSLFNYNFDSLTSDSPVIDAVYTALKEAELRSTDLLPYWKIDLLCKIVPRQIKAE
KAVNIIRNTVEDLITKCKKIVDAENEQIEGEEYVNEADPSILRFLASREEVTSVQLRDDLLSMLVAGHETT
GSVLTWTIYLLSKDPAALRRAQAEVDRVLQGRLPYEDLKELKYLRCINESMRLYPHPPVLIRRAIVDDVL
PGNYKIKAGQDIMISVYNIHRSPEVWDRADDFIPERFDLEGVPVNETNTEYRFIPFSGGPRKCVGDQFALLE
AIVALAVVLQKMDIELVPDQKINMTTGATIHNTTNGLYMNVSLRKVDREPDFALSGSR

SEQ ID NO: 17: barley CYP97C *Hordeum vulgare*:

MPAAAFASALASPPPPWAPRPSRPRHASRLRPPPRSSGGGDKPTTSWVSPDWLTSLSRSLVLRGNDDSGIPV
ASAKLDDVQDLLGGALFLPLFKWFREEGPVYRLAAGPRDFVIVSDPAVAKHVLRGYGYTRYEKGLVAEVSEFL
FGSGFAIAEGALWTVRRRAVVPVSLHKRFLSMVDKVFCKAERLVEKLETYALSGEPVNMEARFSQMTLDVI
GLSLFNYNFDSLTSDSPVIDAVYTALKEAEARSTDLLPYWQIDLLCKIVPRQIKAEKAVNTIRNTVEELI
CKAIVDAENEQIEGEEYVNEADPSILRFLASREEVSSLQRDDLLSMLVAGHETTGSVLTWTIYLLSKDPV
ALRRAQDEVDRLQGRLPYEDVKELKYLRCINESMRLYPHPPVLIRRALVDDVLPNGYKVKTGQDIMISV
YNIHRSPEVWDRADDFIPERFDLEGPVNETNTEYRFIPFSGGPRKCVGDQFALLEAIVALAIVIQKMDVQL
VADQKISMTTGATIHNTTNGLYMNVXLRKVEQADLALSPSG

SEQ ID NO: 18: wheat CYP97C *Triticum aestivum*:

MPAAAFASAFASPPPPWAPRPPRPRHASRLRPPPRSSNNSSGGGDKPTTSWVSPDWLTSLSRSLVLRGNDD
SGIPVASAKLDDVQDLLGGALFLPLFKWFREEGPVYRLAAGPRDFVIVSDPAVAKHVLRGYGYTRYEKGLVAE
VSEFLFGSGFAIAEGALWTVRRRAVVPVSLHKRFLSMVDKVFCKAERLVEKLETYALSGEPVNMEARFSQ
MTLDVIGLSLFNYNFDSLTSDSPVIDAVYTALKEAEARSTDLLPYWQIDLLCKIVPRQIKAEKAVNTIRNTVE
ELITKCKAIVDAENEQIEGEEYVNEADPSILRFLASREEVSSLQRDDLLSMLVAGHETTGSVPDYRLQAQ
GS

SEQ ID NO: 19: tomato CYP97C *Lycopersicon esculentum*:

CRCAERMVEKLLPDAISGSAVNMEAKFSQTLTDVIGLALFNYNFDSLTTDSPVIDAVYTALKEAELRSTDLL
PYWQIKALCKFIIPRQIKAENAVSLIRQTVEELIAKCREIVETEGERINEDEYVNDRDPSILRFLASREEVS
SLQLRDDLLSMLVAGHETTGSVLTWTAYLLSKDPSSLEKAHEEVDRVLGGRSPTYEDMKNLKFLTRCITESL
RLYPHPPVLIRRAQVADVLPNGYKVNVDQDIMISVYNIHSSKVWDRAEEFDPERFDLERSRP

SEQ ID NO: 20: maize CYP97C *Zea mays*:

LEPYALSGEPVNMEARFSQTLTDVIGLSLFNYNFDSLTTDSPVIDAVYTALKEAELRSTDLLPYWKVGFLLCK
IIPRQIKAENAVTIIRNTVEELIMCKEIVEAENEQIEGEEYVNEGDPVILRFLASRDEVSSVQLRDDLLS
MLVAGHETTGSVLTWTIYLLSKDPTALRRAQDE

SEQ ID NO: 21: sunflower CYP97C *Helianthus annuus*:

GPRNFVIVSDPEIAKHVLRLNYGSIYAKGLVAEVSEFLFGSGFAIAEGSLWTARRRAVVPVSLHKKYLSVIVDR
VFCKCSERLVEKLRSYARSDTSVNMEQQFSQTLTDVIGLAVFNYNFDSLTTADSPVIESVYTALKEAEARSTD
LLPYWKISALCKIIPRQIKAEQAVTVIRETVEELIICKKEIVEKEGEKIDDEDYVNDATYIFIC

Figure 24a

SEQ ID NO: 22: rice CYP97C *Oryza sativa*:

[illegible]

SEQ ID NO: 23: barley CYP97C *Hordeum vulgare*:

atgccgcgcgcgcgcattgcctccgcgcgtcgcggtctctctctctccatgggccccacgaccgctccctcgg
cacgctagcctccgcctgccccgcgaaggagcagcggcgcgagggggacaagcccaccacgctcgtgggtc
agccccgactggctcacgtcgtgtcccgcctcgggtgctcggcgggggaaacgacgactcggggatccccgtc
gcctccgccaagctcgacgacgtgcaggacctctcgggggcgcgctcttctctcccgctcttcaagtgggtc
cgcgaggaagggcccgtctaccgcctcgcgcgggggcgcgcgacttcgtcatcgtcagcgaccccgcgcgtg
gccaaacacgtcctccgcgggtacggcacgcggtacgagaaggggctcgtcgcgcgaggtctccgagttcctc
tttggctctgggttcgccatcgccgagggagcgtctggacggtgagacgtagagcagttgtaccatctcta
cacaaaagatttctctcagtaatggttgataaagtgttttgtaaattgtgctgagagattggtggaaaagctc
gagacatatgctttgagcgggtgaacctgttaatatggaagcgagattttctcaaattgacactagatgtgatt
ggtttgtctttgttcaactacaactttgattccctcacatcagatagtcctgtttattgatgctgtttacacc
gactgaaagaagcagagggctcgttctacagatcttttaccatactggcagattgatttgctgtgcaagatt
gttcctagacagatcaaagcagaaaaggcagttaacacaataaggaatactgttgaaagagctaattataaaa
tgcaaggcaatcgtagatgctgaaaatgaacagattgaggggtgaagaatatgtaaattgaggcagatcctagc
atcctgcgttttttacttgctagccgtgaagaggtcagcagtttgagttacgtgatgatctattgtcaatg
ttagttgctgggtcacgaaacaacaggctctgtactgacatggactatttatcttctcagtaaggatccagta
gcactaaggagagcccaagatgaggtagatcgtgttctacaaggtagactcccaagatatgaagatgtaaaa
gagctgaagtacttgatgcgctgtatcaatgagtcctatgcggctatacccacatcctcctgtgctgatacgg
cgtgcactagttgatgatgtgcttccctggaaactacaagggttaagactgggtcaagatatattgatcttctgtg
tacaatattcacagatcacctcaggtatgggacagagcagatgaattcattccagagagatttgatttggag
gggtcccatccaaatgagtcacaaacacaggatttcaggtttatcccttccagtgagggtcctcgaaaatgtgtt
ggagatcagttgttgccttttagaagcaattgtggcacttgcaattgtcatcaaaaagatggcaggttcagctt
gtggcagatcaaaaaatcagcatgaccactggggccaccatccatacaaccaatggactgtacatgaatgta
agntgcgtaaagttgagcaagaagctgacttagcactgaqtccatcaqgcta

Figure 24b

SEQ ID NO: 24: wheat CYP97C *Triticum aestivum*:

atgccccgcccggcattcgccctccgcgttcgcgtctcctcctcctccgtgggccccacgaccgcctcctcgc
cacgccagcctccgcctgccccgccaaggagcagcagcaacaacagcggcggcggcggaggggacaagccc
accacctcgtgggtcagccccgactggctgacgtcgcgtgtctcgcgtcgggtgctcggccgggggaacgacgac
tcggggatacccgctcgccctccgccaagctcgacgacgtgcaggacctcctcgggggcgcgctcttcctgccg
ctcttcaagtgggtccgcgaggaagggcccgcttaccgcctcgcgcggggcgcgcgacttcgtcatcgtc
agcgacccccgcgtagccaagcacgtcctccgcgggtacggcacgcggtagcagaaggggctcgtcgcgag
gtctccgagttcctctttggctctgggttcgccatcgccgagggagcgctctggacggtagacgtagagca
gttgtagcatctctacacaaaagatttctctcagtaattggctgataaagtgttctgtaaagtgtcgtgagaga
ttgggtgaaaagctcgagacttatgctttgagtggtgaacctgttaatatggaagcgaggttttctcaaag
acattagatgtgattgggtttatccttggtcaactacaactttgattccctcacatcagatagtcctgttatt
gatgctgtttacactgcactcaaagaagctgaggctcgtttacagatcttttaccatactggcagatcgat
ttgctgtgcaagattgttcctagacagataaaaagcggaaaaagcagttaacacaataaggaataccggtgaa
gagctaattacaaaatgcaaggcaatcgtagatgcgtgaaaatgaacagattgaggggtgaagaatatgtaa
gaggcagatcctagcatcctgcgggttttacttgctagccgtgaagaggtcagcagtttgagttacgtgat
gatctattgtcaatgttagttgctggcatgaacaacagggttctgtaccagactatcgattacaagcccaa
ggttcc

SEQ ID NO: 25: tomato CYP97C *Lycopersicon esculentum*:

tgcagatgtgctgagagaatgggtggagaaacttttacctgatgcaatttctggctctgcagtgaatatggag
gcaaagttttctcaactaacacttgatgttattggccttgactccttcaattacaattttgattcccttact
actgacagtcagttattgatgcagtttactgcactaaaagaagcagaactccgttcaactgatttggtg
ccatattggcagatcaaagctttatgtaagttcatccacgacaaaataaaggctgagaatgcagtgctatta
atcagacaaaacagttgaagaacttattgcaagtgagagagattgtagaaaactgaggggtgagaggattaat
gaagatgagtagctgaatgatagagatccaagcatccttcgatttttgcttgctagccgtgaggaggtttca
agtttacaacttcgagatgatcttctgtcaatgctagtgtgctgggcatgaaaccacaggttcagttttgact
tggacggcatacctgctgagtaaggaccttcctctttggaaaaagcacatgaggaagtagacagagtttg
ggaggacgctctccgacttatgaagatatgaagaatctcaagttcttaacacgggtgcataactgagtcactc
agactctatccacatccactgtcctgataagacgagctcaagtagctgatgtcctccccgggaattacaaa
gtcaatgttggtcaggatataatgatttcggtatataacattcatcattcttcaaaagtatgggtagagct
gaagaatttgatcctgaaagattcgacttggaagggtcccgtcccaa

SEQ ID NO: 26: maize CYP97C *Zea mays*:

cttgagccatatgctttgagtggggaacctgtcaatatggaagcgaggttttctcagttgacattggatgtg
attggtttatcattgttcaactacaattttgattccctcacacagatagtcctgtcattgatgctgtttat
actgcactcaaagaagcagagcttcgttctacagatcttttgccatactggaagggttggtttcttggtgcaag
ataatcccaagacagataaaaagcagagaatgcggttacgattataaggaacactgttgaagagctgattatg
aagtgtaaagaaatagtgggaagctgaaaatgaacagattgaggggtgaggaatatgtaaacgaaggggatcct
agcattctacgcttctacttgctagccgagatgaggtgaagcagtgtaacaattacgtgatgatctcttgca
atgttagttgctggcatgaaacaacaggctctgtactgacgtggacaatctatcttctcagtaaggatccg
actgcactgaggagagctcaagatgaa

SEQ ID NO: 27: sunflower CYP97C *Helianthus annuus*:

gggccaagaaaactttgtgattgtgagtgacccggagattgctaagcatgtgttgaggaattatgggagtatt
tatgctaaaggccttggtgctgaggtctctgagttcttggttggttttgccattgctgaaggctct
ctttggactgcaaggcgcagggtgtgattccatcacttcacaagaagtacttatcagtaatagttgatcgt
gtattttgcaaatgctccgagaggcttgctgaaaaagctaagatcatacgcacgcagtgacacgtctgttaac
atggagcaacagttttcgagtttaaccttgatgttatcggcttagccgtatttaactacaattttgactca
cttacggccgatagtcctgtaattgaatctgtttataccgcactaaaagaagctgaagcccggttcaactgat
cttttgccatattgggaagataagtgcggttatgtaagattataccaagacaaaataaaaagccgagcaagcagtt
actgtaattagagaaactgtcgaagaacttattataaaaatgcaaggaaatcggttgaaaagggtgaaaaa
atagacgatgaagattacgtaaatgatgcaacctatatcttcatctgc

Figure 25

SEQ ID NO: 28: forward At3g53130 primer
5'-CTTCCTCTTCTTACTCTTCTCTCTTCACT-3'

SEQ ID NO: 29: reverse At3g53130 primer
5'-AAGAACGATGGATGTTATAGACTGAAATC-3'

SEQ ID NO: 30: *LUT1* TaqMan probe
5'-CCGTCTCGCTGCTGGTCCTCG-3'

SEQ ID NO: 31: forward *LUT1* primer
5'-GGATGAATGAGTACGGACCCAT-3'

SEQ ID NO: 32: reverse *LUT1* primer
5'-GGGTCGCTCACAATTACGAAA-3'

Figure 26a

SEQ ID NO: 33: CYP97A3 *Arabidopsis thaliana*:

MAMAFPLSYTPTITVKPVTYSRRSNFVVFSSSSNGRDPLENSVPNGVKSLQEEKRRAELSARIASGA
FTVRKSSFSTVKNGLSKIGIPSNVLDFMFDWTGSDQDYPKVPEAKGSIQAVRNEAFFIPLYELFLTYGGI
FRLTFGPKSFLIVSDPSIAKHILKDNAKAYSKGILAEILDFVMGKGLIPADGEIWRRRRRRAIVPALHQKYV
AAMISLFGEASDRLCQKLDAAALKGEEVEMESLFSRLTLDIIGKAVFNDFDLSLTNDTGVI EAVYTVLREA
EDRSVSPIPVWDIPIWKDISPRQRKVATSLKLINDTLDDLIATCKRMVEEEELQFH E EYMNERDPSILHFL
LASGDDVSSKQLRDDLMTMLIAGHETSAAVLTWTFYLLTTEPSVVAKLQEEVDSVIGDRFPTIQDMKKLKY
TTRVMNESLRLYPQPPVLIRRSIDNDILGEYPIKRGEDIFISVWNLHRSPLHWDDAEKFNPERWPLDGNP
NETNQNFSYLPFGGGPRKCIGDMFASFENVVAIAMLIRRFNFQIAPGAPPVKMTTGATIH TTEGLKLTVTK
RTKPLDIPSVPIPLPMDTSRDEVSSALS

SEQ ID NO: 34: rice CYP97A *Oryza sativa*:

MAATSSAAAAAPPPCRLLGSGQAHLRLPPSAAAAAASARRRLLLRCAASGGNGKGGGGDGS GSDPVLEERRR
RRQAELAARIASGEFTAQGPWAPIPLAVGLAKLGPPELAAALLTKVAGGGGPEIPQAVGSMSAVTGQAFFI
PLYDLFLTYGGIFRLNFGPKSFLIVSDPAIAKHILRDN SKAYSKGILAEILEFVMGTGLIPADGEIWRVRRR
AIVPAMHQKYVTAMISLFGYASDRLCQKLDKAATDGEDVEMESLFSRLTLDVIGKAVFNDFDLSYDNGIV
EAVYTVLREAEMRSTSPIPTWEIPIWKDISPRQKKVNEALALINKTLDELIDICKRLVEEEDLQFH E EYMNE
QDPSILHFLLASGDDVSSKQLRDDLMTMLIAGHETSAAVLTWTFYLLSKYPNVMAKLQDEADTVLGDRLPTI
EDVKKLKYTTRVINESLRLYPQPPVLIRRSIEEDMLGGYPIGRGEDIFISVWNLHHC PKHWDGADVFNPERW
PLDGNPNETNQNF SYLPFGGGPRKCVGDMFATFETVVATAMLVRRFDFQMAPGAPPVEMTTGATIH TTEGL
KMTVTRRTKPPVIPNLEMKIVSDSPENMSTTTSMPSAASIASGEDQQGQVSATRI

SEQ ID NO: 35: barley CYP97A *Hordeum vulgare*:

SARGQAVGSLASVAGEAFFLPLYDLFLTYGGVFRLNFGPKSFLIVSDPDVAKHILRDN SKAYSKGILAEILE
FVMGTGLIPADGEVWRVRRRAIVPALHQKYVTAMIGLFGNASDRLCQKLDKAASDGEDVEMESLFSRLTLDV
IGKAVFNDFDLSYDNGIVEAVYTVLREAEMRSTSPIPTWEIPIWKDISPRQRKVNEALALINNILDELIA
TCKRMVDEEDLQFH E EYMNEKDPSILHFLLASGDDVSSKQLRDDLMTMLIAGHETSAAVLTWTFYLLSKYPN
VMSKLQAEADAVLGDGLPTIDDVKKLKYTTRVINESLRLYPQPPVLIRRSLEDDMLGEYPIKRGEDIFISIW
NLHRCPKHWDDADVFNPERWPLDGNPNETNQNF SYLPFGGGPRKCVGDMFATFETVVATAMLVCRFDFQMA
PGAPPVEMTTGATIH TTKGLNMTVTRRIKPPVIPNLEMKIVSDPEGSTSSSTASVAVSTASIASGEGQQVEVS
TSQV

SEQ ID NO: 36: soybean CYP97A *Glycine max*:

GKGLIPADGEIWRVRRRAIVPALHQKYVAAMIGLFGQAADRLCQKLDAAASDGEDVEMESLFSRLTLDIIGK
AVFNDFDLSLTNDTGIVEAVYTVLREAEDRSVAPIPVWEIPIWKDISPRLRKVNAALKFINDTLDDLIAICK
RMVDEEELQFH E EYMNEQDPSILHFLLASGDDVSSKQLRDDLMTMLIAGHETSAAVLTWTFYLLSKEPRVMS
KLQEEVDSVLGDQYPTIEDMKKKYTTRVINESLRLYPQPPVLIRRSLEDDVLGEYPIKRGEDIFISVWNLH
RSPKLWDDADKFKPERWALDGPSPNETNQNF KYLPFGGGPRKCVGDLFASYETVVALAMLRRFNFQI AVGA
PPVEMTTGATIH TTTQGLKMTVTHRIKPPVIPPSLQ MSTLEVDPSSISLSDQDEV SQKEVYQAQAQS

SEQ ID NO: 37: wheat CYP97A *Triticum aestivum*:

GCRLPQAVGSLASVAGEAFFLPLYDLFLTYGGVFRLNFGPKSFLIVSDPDVAKHILRDN SKAYSKGILAEIL
EFVMGTGLIPADGEVWRVRRRAIVPALHQKYVTAMIGLFGNASDRLCQKLDKAASDGEDVEMESLFSRLTLD
VIGKAVFNDFDLSYDNGIVEAVYTVLREAEMRSTSPIPTWEIPIWKDISPRQCPKHWDADADVFNPERWPL
DGNPNETNQNF SYLPFGGGPRKCVGDMFATFETVVATAMLVCRFDFQMAPGAPPVEMTTGATIH TTKGLNM
TVTRRIKPPVIPNLEMKIVSDSEGSTSSSTASVAVSTASIASGEGQQVEVSTSQV

Figure 26b

SEQ ID NO: 38: tomato CYP97A *Lycopersicon esculentum*:

QFPTHHYSKSRLLTSPKFKGSVSNFTIRCSNSNGKQPESVDEGVKKVEKLLDEKRRRAELSARIASGEFTVEQ
SGFPSSLKNGLSKLGVPKFLEFFSRRTGNYPRIPEAKGSISAIRDEPFFMPLYELYLTYGGI FRLIFGPKS
FLIVSDPSIAKHILKDNSKAYSKGILAEILDFVMGKGLIPADGEIWRVRRRAIVPALHQKYVAAMIGLFGKA
TDRLCCKLDVAATDGEDVEMESLFSRLTLDIIGKAVFNDFDSDLTVDTGIVEAVYTVLREAEDRSVAPIPVW
ELPIWKDISPKLKKVNAALKLINDTLDDLIAICKRMVDEEELQFHEEYMNEKDPSILHFL LASGDEVSSKQL
RDDLMTMLIAGHETSAAVLTWTFYLLSKEPSVMAKLQDEVDSVLGDRLPTIEDLKKLRYTTRVINESLRLYP
QPPVLIRRSIEEDVVGGYPIKRGEDIFISVWNLHRCPNHWEEADRFPNPERWPLDGPNPNETNQNF SYLPFGG
GPRKCVGDMFATFENLVAVAMLVQRDFQMALGAPPVKMTTGATIHTTEGLKMTVTRRSRPPIVPNLEMATL
EVD

SEQ ID NO: 39: green alga CYP97A3 *Chlamydomonas reinhardtii*:

ARRRAVVPALHRKYVMSMVD MFDCAAHGASATLDKYAASGTS LDMENFFSRLGLDIIGKAVFNDFD SLAH
DDPVIQAVYTLLREAEHRSTAPIAYWNIPGIQFVVPQRKRCQEALVLVNECLDGLIDKCKKLVEEEDAVFGE
EFLSERDPSILHFL LASGDEISSKQLRDDLMTMLIAGHETTAAVLTWTL YLLSQHPEAAAAAIRKEVDELLGD
RKPGVEDLRALKMTTRVINEAMRLYPQPPVLIRRALQDDHFDQFTVPAGSDFISVWNLHRSPKLWDEPDKF
KPERFGPLDSPIPNEVTENFAYLPFGGGRRKCIGDQFALFEAVVALAML MRRYEFNLDESKGTVGMTTGATI
HTTNGLN

Figure 27a

SEQ ID NO: 40: CYP97A *Arabidopsis thaliana*:

gtgatttgagttttttatgttgcggtggcggttgatggctatggcctttcctctttcttataactccgacgat
tactgttaaaccagtaacgtactctcggagatcgaactttgtagttttctcgtcaggttctaattggacgag
atccttttagaggagaattcagtacctaattggtgtgaaaagcttggagaagcttcaagaagagaagcgctcgt
gctgagttatctgctaggattgcttctggagctttcactgtacggaaatctagttttccatctacagtga
gaatggtttatctaagattggaataccaagcaatgttcttgatttcatgtttgattggaactggttctgacc
aagactaccccaaggttccctgaggctaaaggctcgattcaggcggtccggaacgaagctttcttcatccct
ttgtatgagcttttcttacttattggtggaattttcaggttgacctttgggcctaagtcattcttgatcgt
gtcggatccttctatttgctaaacatatattgaaggacaatgcaaaagcttactccaaggggatttttagctg
aaattctagattttgtgatgggaaaaggactcattcctgctgatggggagatatggcgtagacgaaggcgt
gccattgttccctgcattgcatcaaaagtatgtagcagctatgattagtttattcggagaagcttcagatag
gctttgtcagaagcttgatgctgctgcattgaaaggggaagaagtagagatggaatcactcttctctcgtt
tgacacttgatattatttggaaggcggttttcaattacgactttgactcccttactaatgataccggtgtg
atcgaggcagtgtagactgttctaagagaagctgaagacagaagtgtttcacctattcctgtttgggacat
accatttggaaagatatttcccccacgtcagaggaaagtgtacttcttgaaattaatcaatgacacac
ttgatgatttgattgcaacatgcaagagaatggtagaagaaggaggttgacgtttcacgaggagtatatg
aacgaaagagatcctagcatccttcttctttagcttcaggagatgatgtctctagtaagcagcttcg
tgatgacttgatgacaatgcttatagccggacatgaaacatcggcggcagtttaacatggacctttacc
ttttaacaacggaaccaagtgtagttgccaaacttcaagaagaggttgattctgtaattggagatagattc
ccaaccatacaagatatgaaaaagctgaaatacactactcgagtcattgaatgagtcattgagattatatcc
acaaccaccagtactgatccgtcgttctatagataatgatatacttggagagtatccgataaaaaggggag
aggatatcttcatctcggtttggaaatctacatcgaagtcctctgcattgggatgatgcagagaagttcaat
cccagagatggcctttggatggaccaaaccctaatgagacaaaccaaacttcagttacttacctttcgg
tggaggaccgcggaatgtataggcgacatgtttgcttcttcttgagaatgtggttagcaatcgcaatgctta
ttcgaagatttaactttcagattgcaccaggagctcctccggtgaaaatgactacaggagctacaatacac
accacagaaggattgaaattgacagtaacaaaggagacaaaacctctggacataccatccgtaccgatact
tccaatggatacttcacgggatgaagtttcatctgctcttctttaaagtcttcatctttacaaaactgaaaa
caaacaagctcagatgaagaagcaaaaatcttggttagaacagcaaatgttgaattggttggaacatgacc
aatgctttctgatttttctgctgctgtaaaatgcagacaagttaaatagagaagatttattattctttgg
aaaaaaaaaatgtttttgtctgcacagtgaagataataaacttctgggttctatgtaaaaaaaaaaac

Figure 27b

SEQ ID NO: 41: CYP97A *Arabidopsis thaliana*:

atggctatggcctttcctctttcttatactccgacgattactgttaaaccagtaacgtactctcggagatcg
aactttgtagttttctcgtcgcgagttctaatggacgagatccttttagaggagaattcagtacctaattggtgtg
aaaagcttggagaagcttcaagaagagaagcgtcgtgctgagttatctgctaggattgcttctggagctttc
actgtacggaaaatctagttttccatctacagtgaagaatggtttatctaagattggaataccaagcaatggt
cttgatttcatgtttgattggactggttctgaccaagactaccccaagggttcctgaggctaaaggctcgatt
caggcgggtccggaacgaagctttcttcatccctttgtatgagcttttccttacttattggtggaattttcagg
ttgacctttgggcctaagtcattcttgatcgtgtcggatccttctattgctaaacatatattgaaggacaat
gcaaaagcttactccaaggggatttttagctgaaattctagattttgtgatgggaaaaggactcattcctgct
gatggggagatatggcgtagacgaaggcgtgccattgttcctgcattgcatcaaaagtatgtagcagctatg
attagtttattcggagaagcttcagataggctttgtcagaagcttgatgctgctgcattgaaaggggaagaa
gtagagatggaatcactcttctctcgtttgacacttgatattattggcaaggcggttttcaattacgacttt
gactcccttactaatgataccgggtgtgatcgaggcagtgtagactgttctaagagaagctgaagacagaagt
gtttcacctattcctgtttgggacatacccatttggaaagatatctccacgctcagaggaaaagttgctact
tccttgaaattaatcaatgacacacttgatgatttgattgcaacatgcaagagaatggtagaagaaggaggag
ttgcagtttcacgaggagtatatgaacgaaagagatcctagcatccttcactttcttttagcttcaggagat
gatgtctctagtaagcagcttcgtgatgacttgatgacaatgcttatagccggacatgaaacatcggcggca
gtattaacatggaccttttaccttttaacaacggaaccaagtgtagttgccaaacttcaagaagaggttgat
tctgtaattggagatagattccaaccatacaagatatgaaaaagctgaaatacactactcgagtcatgaat
gagtcattgagattatatccacaaccaccagtgatccgtcgttctatagataatgatatacttgggagag
tatccgataaaaaggggagaggatatcttcatctcggtttggaatctacatcgaagtcctctgcattgggat
gatgcagagaagttcaatcccgcgagagatggcctttggatggaccaaaccctaatgagacaaaccaaacttc
agttacttacctttcgggtggaggaccgcggaaatgtataggcgacatgtttgcttcctttgagaatgtggtg
gcaatcgcaatgcttattcgaagatttaactttcagattgcaccaggagctcctccggtgaaaatgactaca
ggagctacaatacacaccacagaaggattgaaattgacagtaacaaaggagacaaaacctctggacatacca
tcctgtaaccgatacttccaatggatacttcacgggatgaagtttcatctgctcttttcttaa

Fig. 27c

SEQ ID NO: 42: rice CYP97A *Oryza sativa*:

atggcggctacctcctctgcgccgcccgtgctccacctccgtgcccgttactcgggtccgggtcaggcacac
ctgcgcccttctccttctgctgctgctgctgctgctcagctcgtcgccgctgctcctccgctgcccgc
tcggcggaacgggaaaggcgggtggcgacgggtccgggtccgacccggttcttgaggagcggcgccg
cggcgccagggtgagctggcgccggtcattgctccggcgagttaccgcccaggccccgcgtcagtgctc
attctctctctctctctctctcacgttgcgccgcttctccttctcctttgatgatctgatggagagctcc
ctctctctttttcagggtgattgctccctcgcggtggggcttgccaagctcgcccccacgggggagctcgc
cgccgcgtgctcaccaaggctcgccggtggcgccgacggagataccgcaggcgggtggggtctatgagtgc
ggtgacagggcaggcttcttcatcccgtctatgatctcttcttacctatggcggtcattcttgcctcaa
tttcggccctaagggtgatgcacaatcagaccaatttgctctccaactcggcaactcccaattttgtgttatt
attgatggcctaactttgttcttttctgttttcccagctcttctctcattgtctctgatccagctatagc
taagcacatcctgagggacaaactccaaggcttattccaaggttttgtgtgtgtcaattttggatgtagagtg
ttctaggctgtgctctagaaattaacggcctgcatttttgattgtgtgggtgcagggtattctggcagaaat
tttagagtttgatgggtacgggttgatccctgctgatggggagatttgcggtgtaggaggcgcccat
tgtaccagcaatgcaccagaagggttctacatcatttctgtaccaggttttagcatgatttgatcttcgggttg
tgattgaactgatctgaatttcgctttgcagtacgttaccgcaatgataagtctcttcggatatgcttcaga
tcggctctgccagaagttggacaaggcagcaacggatggggaggatgtggagatggaatctttgttctctcg
actaacactggatgtcattgggaaggcagcttcaattatgatttcgactcattgtcttacgataatggaat
agttgaggttagtattcagctctgtactgtaattttggaattcattatacattctattttgttcattgtttgtt
ttcttaaaattttaccttttttggattgatgatcaggcagtgatgtgacactgcgagaagcagaaatgcg
gagcacttctcctataccaacttgggaaatacccatatggaaagataatttccccgcggcagaagaaggctcaa
tgaagctcttgcgctgataaataagactcttgatgaactaattgacatctgcaagggtgaacttcttttctta
tgttctgacctattatttttttaaaaaaatcaaggcttttagattggctgctgttactcttgacagaga
ttggtcgaggaagaagatctgcagtttcatgaagaatacatgaatgagcaagaccccgatctctccacttt
cttttggcatctggagatgatgtatgggtgtacctgcagtttaaaatattatagatctccaaacattctggctc
ctcacattgcttcaattttgtcttcattaggtctccagcaagcaactccgtgatgatctgatgacaatgctca
ttgctggccatgagacctctgcagcagctcttgacatggacattttatcttctatctaagggtatcaatatgtt
ccgtagctgttccaaaagaaaaatattgttcagcaactcaaatcattgatgtattaatgtagcaatatgta
gatgaatattgtatacgtcaaaccactcatgttttacctttcttggcattggtaacttgcagtatccaaatg
taatggccaaactccaagatgaggtaaattcgctttacatttaggattgttatttttagaggcacgtgctt
ctacatcttacaagttgcaaatgacttgtttcactcacttatggacaggctgatactgttctaggtgacgtt
ttaccaacaattgaggatgtgaagaaattgaagtatactactagagtaattaacgaagtaagtgaataacag
tgctacctcattaaacaatgagtgatgatcactgaatgaatatgtcattcaatcaccacttttgcagtcattg
agactctatccacagccaccagttttaattcgctcgtcttattgaggaggatatgctgggagggtacccaatt
ggccggttaaagaaaaactctagcagaacttatttctcaagtgtaggaaatctctcctgtagtctgttgactg
ttgttacaattggaataggaaaacagaaagatcatgcctagatcacaccagtaaaagtctgggtgaaactga
gtctaaggccctctttatttaggtttaagtttatttggttttagtattttaagtcagtttttttggttatatg
atttataagccaatggatttaaagtcctaagtttaattggtggagtcatacctctatctcacataagccaaaa
aaccttttccaaactagcttttcttctaatagtgtaacagttcgctgagccttaatagtgtaatagtgggtt
atggcttttaaaaaaacatgcgaaaagctgtttgtttgtttaggcttagacttttcagctcataagctggc
ttataagcctaaacaaagagggcctaagatatgtgcaagtataagttatctaaccaatcttttttagagaa
tatcttcccaatcttgtgtgatataattttgtcttctgcttgataaccatttctggctgtagctctagagta
tttaattgtctgaattgttccttttaaaaaatttcagtacaaatttgaacttcaactataattctgataaga
tattttttccctttgtttccaggggagaaagacattttcatatccgtgtggaacctacatcattgcccgaag
cattgggatgggtgcagatgtttttaatccagaaagatggcctttggatggaccaaataccaaatgaaacaaac
caaaatttcagggtccatctctattaatgctatgaaatgcattagctctttatttggatgcaccttatcact
ctaattccccattttatttagtttctgcttctactacaaaaatcagtagacatttgattatgctcgggtata
gttggtgtctgtttgacgagaagtttgctttttacatctactaacactaagttatttgggtcatgcatgac
acctgttgtaattattctagagataacaaaaacaaaaactctagctgatttttcgttttcttctttgatgcaa
atcatcaaaattttcttcatgtgattcgtattaatttagtgctaagtggcatgtgcatagccacaactcta
gaaagtgcataaggcagtcacaacaacataaaagaaaaatgggaccttttcttttgaagcagtaaaagatgag
ataactgtgatgacttgattcctaatttatgggtttgggagctaaaccacagtttatgacaatcatgttaa
aatgatattcatatggctataagcaacatgtgccaaaatgctattgtactttcaactgatagtgttgaaa
gtacttttcaactttaccacatcgccagaactgttaactgggttacgcagaaacagtaacttggaaatagtaatt
ttgtataaactgatagtagtgcgtatgagttccttacctgtagcaagtagtcaacagcagaaccttttgta
tggatcaacaaacatcagaggtgcttgaacaaaatccttacttgattagaagacgtaacaattcgtgcat

Figure 27d

cctgagttaatgaagacttccgactggactacaaaacttcttccgtgttgagtccttgaggaggtgatgca
cggcataaaacctgtgacctgcaaatcatgttaattgaaaaacaaccaacgtatcatcaactataatgtaca
gcaagtctcctagggcatcacactgaaacttaaaaatggtaatctgcatttacttggcacatgacatgtccca
ttattttgtcagcttagattgaactcactgcggaacacatcttctttcaagacaacatccaaattattgat
tttcagttggcatgtcaaaactttttaagctccaatttttaggctgtggttagctttcattctgtgtattgcggc
tagcatctgttagctgtcactgcctcactggctaatttaatatatttgatgaatctacatagctaaatggga
ctcacgtgttctgttgaattctcagttacttgccatttggtggcggaccaaggaaatgtgtaggtgacatgt
ttgccactttcgaggtaatttgttttagttttgaaggatttcttcttttaatttcaaaatgtcattttaag
gaaacatagcaaaacttatgtatgggtccagtcttactgaaccttgttgccttgagccttctgttgtctacat
aaggacattatatctcatgccatgataaataatgtagtacaataactattgagcatgcaagattccaactct
aataacatggatatgccggaacttgtatgcagactgtggtggcaactgcaatgcttgtcaggcgctttgatt
ttcaaatggctccaggagctcctccgtataatttctgtctgttctcctggttcttcatagttatcaacatac
agataatcactgtgaagtatcaatatgataggttgagatgacaactggagcaacgattcacacaactgaggg
gttgaaaatgactgttactcgaggacaaaagccacctgtaatcccaaaccctagagatgaaagtcatttctga
ttcaccagaaaacatgagtactactacatcaatgccggttctgtctgctagtattgcttcaggagaagatca
acaagggaagtctcagcaactcgaatctga

Figure 27e

SEQ ID NO: 43: rice CYP97A *Oryza sativa*:

atggcggctacctcctctgcgccgcgctgctccacctccgtgcccgttactcgggtccgggtcaggcacac
ctgcgcttctcctccttctgctgctgctgctgctgctcagctcgccgctgctcctccgctgcgccgcc
tcggcgcgcaacgggaaaaggcgggtgggtggcgacggctccggctccgacccggttcttgaggagcggcgcg
cggcgccaggctgagctggcgcgcgcatctgctccggcgagttcaccgcccaggcccccgctggattgct
cccctcgcggtggggcttgccaagctcggcccaccgggggagctcgccgcccgcgctgctcaccaaggctgcc
ggtggcgcgcgagaccggagataaccgcaggcgggtggggctctatgagtgcgggtgacagggcaggctttcttcac
ccgctctatgatctcttcccttacctatggcggcacatcttccgctcaatttcggccctaagtcttcttcatt
gtctctgatccagctatagctaagcacatcctgagggacaactccaaggcttattccaagggtattctggca
gaaatttttagagtttgatgggtacgggttgatccctgctgatggggagatttggcgtgttaggagggcg
gccattgtaccagcaatgcaccagaagtacgttaccgcaatgataagtctcttcggatatgcttcagatcgg
ctctgccagaagttggacaaggcagcaacggatggggaggatgtggagatggaatcttcttctcgcacta
acactggatgtcattgggaaggcagctcttcaattatgatttcgactcattgtcttacgataatggaatagtt
gaggcagtgatgtgacactgcgagaagcagaaatcgggagcacttctcctataccaacttgggaaataccc
atatggaagataatttcccccgcgcgagaagaaggctcaatgaagctcttgcgctgataaataagactcttgat
gaactaattgacatctgcaagagattggctcgaggaagaagatctgcagtttcatgaagaatacatgaatgag
caagaccccagtatcctccactttcttttggcatctggagatgatgtctccagcaagcaactccgtgatgat
ctgatgacaatgctcattgctggccatgagacctctgcagcagctcttgacatggacattttatcttctatct
aagtatccaaatgtaatggccaaactccaagatgaggctgatactgttctaggtgaccgtttaccaacaatt
gaggatgtgaagaaattgaagtatactactagagtaattaacgaatcattgagactctatccacagccacca
gttttaattcgtcgctctattgaggaggatgtgctgggagggtagccaattggccgggggagaagacattttc
atatccgtgtggaacctacatcattgcccgaagcattgggatggtgcagatgtttttaatccagaaagatgg
cctttggatggaccaaataccaaatgaaacaaaccaaatttcagttacttgccatttgggtggcggaaccaagg
aaatgtgtaggtgacatgtttgccactttcgagactgtggtggcaactgcaatgcttgtcaggcgctttgat
tttcaaatggctccaggagctcctccggttgagatgacaactggagcaacgattcacacaactgaggggttg
aaaatgactgttactcggaggacaaaagccacctgtaatcccaaacctagagatgaaagtcatttctgattca
ccagaaaaatgagtactactacatcaatgcccgtttctgctgctagtattgcttcaggagaagatcaacaa
gggcaagtctcagcaactcgaatctga

SEQ ID NO: 44: CYP97A barley *Hordeum vulgare*:

tcggcacgagggcaggccgctcggtgctggcttccgctcgccgggaggccttcttctcgctctacgac
ctcttctcacctacggcgcgctcttccgctcaacttcgggcccgaagtcttctcctcatcgctctgatccg
gatgtagctaaagcatatcctcagggacaactcaaaggcttattccaagggtatccttgcggaataactggag
tttgatgagggcacaggctctgatcccggtgatggggaggtctggcgtgttcgacggcggtgccattgtacca
gcattgcatcagaagtacgtgacagcgatgataggtctctttggaaacgcttcagaccggctctgccagaag
ctcgacaaggctgcttcggacggggaggatgtggagatggaatctctcttctcccgactaacgctggatgtc
atcggaaggcgggtgttcaattatgattttgattcattatcttacgataatggaatagttgaggctgtgta
tgtaacactgcgggaagcagaaatgcggagtagatctcctattccaacatgggaaatacccatatggaaag
acatctccctcggcagaggaaggctcaatgaagcgcttgactgataaataatattctcgatgaactaatt
gctacgtgcaagaggatggtagatgaagaagatctgcagtttcatgaggaatacatgaatgagaaagacc
tagtattcttctactttctattggcatctggagatgatgtgtccagcaagcagctccgtgatgacctgatga
caatgctcatagctggccatgagacctctgcagcagctcttgacatggacattttatcttctatctaagtat
cccaacgtaatgtccaagctccaagctgaggtgatgctgttctaggagatgggtctgccacaattgatga
tgtgaagaaactgaagtatactactcgagttattaatgaatctttgagactatacccacagccgccagttt
taattcgccgctcccttgaggatgatatgctaggagagtagccgatcggaagggagaagatatttttatat
ccatctggaaccttcatcgctgcccgaagcattgggatgacgcggatgttttcaatccggaaagggtggcctt
tggacggaccgaatccaaatgagacaaacaaaaattcagttacttgccatttgggtggcggaaccaaggaaat
gtgtaggatgatgtttgctacttttgagactgtggtagcaacagcaatgcttgcagcgaatttgattttc
agatggctccaggacacctccgctcgatgacaaacggagcaacgattcacacaactaagggactgaaca
tgactgttactcggaggataaaagccacctgtaattccaaacttagagatgaaaatcgtttccgatccagaag
gaagcacaagttctactgcgtcagtggtgtttctactgctagtattgcatccggagaaggtaacaagtgg
aggtgtcgacaagtcaagtgtga

Figure 27f

SEQ ID NO: 45: soybean CYP97A *Glycine max*:

gggaaagggccttatcccagctgatggtgaaatatggcgagtttagacgtcgtgctatagtcacagcattgcac
cagaagtatgtagcagctatgattggccttttcggacaagctgcagataggctctgccagaagctagatgct
gctgcatccgatggagaagatggtgagatggaatcacttttctctcgattgaccttgacatcattggcaag
gcagatttcaattatgattttgatagtttatcaaatagacactgggtatagttgaggctgtttatactgtactg
agagaagcagaagatcgaagtgttgctccaattccagctctgggagatcccaatatggaaagacatatcacca
cgtctaaggaaggttaatgcagctctcaaattcatcaatgatacgccttgatgatctgatagcaatatgcaag
agaatgggtggatgaagaagagttacagtttcatgaggagtacatgaatgagcaagatccaagtattctacac
ttcttgttggcgtcaggagatgatgtgtcaagtaagcaacttcgtgatgacttaatgaccatgctcattgct
ggacatgaaacatcagctgctgttttaacttgaccttttatcttctatccaaggagccaagagtcagtgcc
aagctccaagaagaggttgactctgtacttgagatcaatatccaactatagaagacatgaagaaactcaaa
tatacaacccgagtgatcaatgagtcattgaggctttaccacaaccacctgtgttaattcgccgctctctt
gaggatgatgttcttggagagtaccctataaagagaggtgaagatatctttatatctgtatggaacctgcat
cgagtcctaaaactatgggatgatgctgacaagtttaaacctgaaagatgggcatttagatggaccaagtcct
aatgagacaaatcaaaacttcaaatatcttccgtttgggtggcgaccacggaaatgtgtagggtgatttgtt
gcttcatacgagacggttagtagcactcgcaatgcttatgagacgattcaactttcaaatagcagttggagct
ccaccggttgagatgactactggagctacaattcatacaacacaaggggtgaagatgactgtaactcacaga
ataaaaacctcctattgtgccctcattacagatgtcaactttggaagtggatccatccataagcctttctgat
caagatgaagtaagtcagaaaaggcgaagtttaccaggctcaggctcagtcctaa

SEQ ID NO: 46: wheat CYP97A *Triticum aestivum*:

Ggctgcaggctgccgcaggcggctcgggtcgctggcgtccgtcgccggggaggccttcttctcgtccgctctac
gacctcttctcacctacggcggcgtcttccgcctcaacttcgggcccagtccttctctcatcgtctctgat
ccgatgtagctaagcatatcctgagggacaactccaaggcttattccaagggtatccttgcggaaatattg
gagtttgtgatgggcacaggtctgatcccggtgatggggaggtctggcgtgttcgacggcgtgccattgta
ccagcattgcatcagaagtacgtgacagcgatgataggtctcttcggaaatgcttcagaccgtctgtgccag
aagctggacaaggcggcatccgatggggaggatgtggagatggaatctctcttctctcgactaacgctggat
gtcatcgggaaggcagtggtcaattatgattttgattcattatcttacgataatggaatagttgaggctgtg
tatgtaacattacgggaagcggaaatgcggagcacatctcctattccaacttgggaaataccatagtgaaa
gacatctcccctcggcagagtgcccaaagcattgggacgatgcggatgttttcaatccagaaagggtggcctt
tggacggaccgaatccaaatgagacaaacaaaaattcagttatttgccatttggtggcgggccaaggaaat
gtgtaggcgatatgtttgctacttttgagactgtggtggcaacagcaatgcttgtcaagcgatttgattttc
agatgggtccaggagcacctccggtcgagatgacaactggagcaacgattcacacaactaagggaactcaaca
tgactgttactcggaggataaagccacctgtaattccaacttagagatgaaaatcgtttccgattcagaag
gaagcacaaagttctactgcgtcagtggtgttttctactgctagtattgcatccggagaagggtcaacaagtag
agggtgctcacaagtcaagtgtga

Figure 27g

SEQ ID NO: 47: tomato CYP97A *Lycopersicon esculentum*:

caattttccaacacaccattactctaaatctagactcactctctcacctaaattcaagggtagtgatcaaat
tttacaattaggtgttctaatctaatggaaaacagcctgagtcggtagatgaaggagtcaaaaaggtggaa
aagcttttagatgagaaaaggcgagctgaattatctgctcgtattgcttcaggcgaatttactgttgaacaa
tctggcttcccgtcatttgctcaaaaatggtttgctaaattgggtgtaccaaaggaatttcttgagttcttc
tctcgacgaacgggcaattatcctcgcatccagaggcaaaaaggatccatcagtgctattcgggatgagcca
ttcttcatgccgctttatgagctttaccttacttatggcggaattttccgggtgatttttgggtcccaagtct
tttttaatagtttctgatccatcaatagccaaacacatactgaaagataattctaaaggcttattctaaagggt
atcctagctgaaatattggactttgtgatgggaaagggacttatacctgcagatggagaaatttggcgcgctc
aggcgcgctgccattgtaccagcattgcaccaaagtagctagcagctatgattggcttatttggaaaagca
accgataggttgtagaaaagcttgatgttgctgcaactgatggagaagatgtagagatggaatcacttttc
tcccgctaacattggacatcattggcaaagctgtatttaattatgattttgactctttaactgtagatact
ggtatcgtggaggctgtatatacagtacttagagaagcagaagatcgtagtggtgcaccaattccagtttg
gagttgcctatctggaaaagatatctctccgaagctaaaaaagggttaatgcagctctcaagttgattaatgac
acattggatgatctgattgctatatgtaagaggatggtagacgaagaagagttgcagtttcacgaggaatac
atgaatgaaaaagatcctagcatcctccatttcttgtagcatctggagatgaggtctcaagcaagcaactc
cgtgatgacctcatgacaatgcttatagcgggacatgaaacatctgcagcagtgctcacatggaccttttat
ctgttggtccaaggaacctagtgtcatggccaagcttcaagatgaggtcgattcagttctaggggatagggtta
ccaaccattgaagatctaaagaaactcagatacacaactcgtgtgattaatgagtccttaagactatatcca
cagccaccagtccttgattcgtcgttctattgaagaggacgtagttggaggttaccgattaaaaggggtgaa
gacattttcatcttctgtttggaacttgcatcgatgccgaatcattgggaagaagccgatagattcaatcct
gagaggtggccacttgatggacataacccaaatgagacgaacccaaaatttcagttaccttcccttcggtgg
ggaccaagaaaatgtgtgggagacatagtttggccactattgagaatttagtagcagttgcaattgcttggttcaa
cgatttgattttcaaatggctcttggaagctcctcctgtttaaagtacaactgggggtaccatccacaccaca
gaaggattaaaaatgactgtaacacgaagatcaagacctccaatagttcccaacttggagatggcaacatta
gaagtagat

SEQ ID NO: 48: CYP97A like gene *Chlamydomonas reinhardtii*:

gcgcgccgacgcgcagtggtgccagccctgcaccgcaagtagctgatgtcgatggtggacatgttcggcgac
tgcgcggcgacggcgcgctccgccacactagacaagtatgccgcctcaggcaccagcctggacatggaaaac
ttcttcagccggctgggtctggacatcatcggaaggcggtgttcaactacgacttcgactcgctggcgac
gacgaccccgatcatccaggccgtgtacacgttgctgcgcgaagcggagcaccgctccacagcgcccatcgcc
tactggaacattcccgcatccagtttggtggtgccgcggcagaagcgctgccaggaggcgctggtgctggtta
aatgagtgcctggacggcctcatcgacaagtgaagaagctggctcgaggaggaggacgcgggtgtttggggag
gagttccttagcgagcgcgacccctccatcctgcacttcctcctcgcgctctggagacgagatttcctcgaag
cagttgcgcgatgacctgatgactatgctgattgcggggcacgagaccaccgcccgcgtgctgacgtggacg
ctgtacctgctgtcccaacacccccgaggcggcagcgcccatccgcaaggaggtagacgagctccttggggac
cgcaagccccggggtggaagacctcagagcgctcaagatgacgactcgcgtcatcaacgaggcgatgcggctc
taccacagccgccagtaactattcgccgcgcgtgcaggacgaccacttcgaccagttcacgggtgccggcc
ggcagcgacctgttcatcagcgtgtggaacttgaccgcagccctaagctgtgggacgagcccgacaagttc
aagccggagcgcttcggaccgcgtggacagccccatccccacgaggtgactgaaaacttcgcctacctgcc
tttggcggtggccgcgcgaagtgcattggcgaccagttcgcttgctcgaggcggttgttgcgctggccatg
ctgatgcggcgatacagagttcaacctggacgagtcgaaggggacagtgggcatgacaacaggtgccaccatc
cacaccaccaacggtctaaac

Figure 28

SEQ ID NO: 49: CYP97B3 *Arabidopsis thaliana*:

MAFPAAATYPHTFQGGALHLGRTDHCLFGFYPTISSVNSRRASVSIKQSTEPKTNGNILDNASNLLTNF
LSGGSLSGSMPTAEGSVSDLFGKPLFLSLYDWFLEHGGIYKLAFGPKAFVVISDPIIARHVLRENAFSYDKG
VLAIEILEPIMGKGLIPADLDTWKLRRRAITPAFHKLYLEAMVKVFSDCSEKMILKSEKLIREKETSSGEDT
IELDLEAEFSSLALDIIGLSVFNDFGSVTKESPVIAVYGTLFEEAHRSTFYFPYWNFPARWIVPRQRK
FQSDLKIINDCLDGLIQNAKETRQETDVEKLQERDYNLKDASLLRFLVDMRGVDIDDRQLRDDLMTMLIA
GHETTAAVLTWAVFLLSQNPEKIRKAQAEIDAVLGQGPPTYESMKLEYIRLIVVEVLRLFPQPPLLIIRRT
LKPETLPGGHKGEKEGHKVPKGTDIFISVYNLHRSPYFWDNPHDFEPEFLRTKESNGIEGWAGFDPSPSP
GALYPNEIIADFAFLPFGGGPRKCIGDQFALMESTVALAMLFQKFDVELRGTPESVELVSGATIHAKNGMW
CKLKRRSK

SEQ ID NO: 50: pea CYP97B1 and CYP97A2 *Pisum sativum*:

MVAAPISTVKLTDANLHTRFHSSSSSTPSTLSLPLSLHFHSSHSKRFSIRCQSVNGEKRKQSSRNVDN
ASNLLTSLLSGANLGSMPIAEGAVTDLFDRLPFFSLYDWFLEHGSVYKLAFGPKAFVVVSDPIVARHILRE
NAFSYDKGVLAIEILEPIMGKGLIPADLETWKQRRRVIAPGFHTSYLEAMVQLFTSCSERTVLKVNELLEGE
GRDGQKSVELDLEAEFSNLALIEIIGLVFNDFGSVTNESPVIAVYGTLFEEAHRSTFYIPYWKFLARW
IVPRQRKFQDDLVINTCLDGLIRNAKESRQETDVEKLQORDYSLNKDASLLRFLVDMRGVDVDDRQLRDD
LMTMLIAGHETTAAVLTWAVFLLAQNPDKMKKAQAEVDLVLMGKPTFELLKKLEYIRLIVVETLRLYPQP
PLLIRSLKPDVLPGGHKGDGDYTIPTAGTDVFISVYNLHRSPYFWDNPDPFEPERFLVQNNNEEVEGWAG
FDPSPSPGALYPNEIISDFAFLPFGGGPRKCVGDQFALMESTVALVCCYRISMWN

SEQ ID NO: 51: soybean CYP97B2 *Glycine max*:

MSVDTSSSTLSTVTDANLHSRFRHSLVPFTHHFSLSQPKRISSIRCQSINTDKKKSSRNLLGNASNLLTDLL
SGGSIGSMPIAEGAVSDLLGRPLFFSLYDWFLEHGAUVYKLAFGPKAFVVVSDPIVARHILRENAFSYDKGV
LADILEPIMGKGLIPADLDTWKQRRRVIAPAFHNSYLEAMVKIFTTCSERTILKFNKLEGEYDGPDSIE
LDLEAEFSSLALDIIGLVFNDFGSVTKESPVIAVYGTLFEEAHRSTFYIPYWKIPLARWIVPRQRKFQ
DDLKVINTCLDGLIRNAKESRQETDVEKLQORDYSLNKDASLLRFLVDMRGADVDDRQLRDDLMTMLIAGH
ETTAAVLTWAVFLLAQNPDKMKKAQAEVDLVLTGRPTFESLQELQYIRLIVVEALRLYPQPPLLIRSLK
SDVLPGGHKGEKGDYAIPTAGTDVFISVYNLHRSPYFWDNPDPFEPERFLVQNKNEEIEGWAGLDPSRSPGA
LYPNEVISDFAFLPFGGGPRKCVGDQFALMESTVALTMLLQNFDELKGTPESEVELVTGATIHTKNGLWCN
LKRSSLH

SEQ ID NO: 52: rice CYP97B4 *Oryza sativa*:

MAAAAAAVPCVPFLCPPPPPLVSPRLRRGHVRLRLRPPRSSGGGFTGGGGAGGDEPPITTSWVSPDWLTA
LSRSVATRLGGGDDSGIPVASAKLDDVRDLLGGALFLPLFKWFREEGPVYRLAAGPRDLVVVSDPAVARHV
LRGYGSRYEKLVAEVSEFLFGSGFAIAEGALWTVRRRSVPSLHKRFLSVMVDRVFCKCAERLVEKLETS
ALSGKPVNMEARFSQMTLDVIGLSLFNFDLSLTSDSPVIDAVYTALKEAELRSTDLLPYWKIDLLCKIVP
RQIKAEKAVNIIRNTVEDLITCKCKIVDAENEQIEGEEYVNEADPSILRFLLASREEVTSVQLRDDLLSML
VAGHETTGSVLTWTIYLLSKDPAALRRAQAEVDRVLQGRLPYEDLKELKYLKRCINESMRLYPHPPVLIR
RAIVDDVLPNGYKIKAGQDIMISVYNIHRSPEVWDRADDFIPERFDLEGVPVNETNTEYRFIPFSGGPRKC
VGDQFALLEAIVALAVVLQKMDFTIELVPDQKINMTTGATIHNTNGLYMNVNIGVQVDEARKHGYNSFIV
YGYTLAYISPRIWSAMPVL

Figure 29a

SEQ ID NO: 53: CYP97B3 in *Arabidopsis thaliana*:

atggccttttctgcccgtgctacttatcccccatttccaaggcggcgctcttcatctgggtaggaccgat
cattgcctcttcggtttctaccctcaaaccatttctctgtgaattctcggagagcttctgtttccatcaag
tgccaatctacggagccaaagacgaatggtaacatattggacaatgcgagcaaccttttgacaaatttttta
agtgggtggaagtttgggggtcaatgcctactgctgaaggctctgtctctgatttgtttggaaagcctctcttt
ttatctctttacgactgggttcttggagcatggaggaatttataaaacttgcgtttgggtccaaaagcctttgtt
gtcatctcagatcccattatttgaaggcatgtcctccgggaaaaatgctttttcttatgacaagggagttctt
gctgagatcttagagccgatttatgggaaaagggttaataccggctgatctagatacgtggaagttaagaaga
agagctatcactcccgcattccataaaattgtatctagaggccatgggtcaaagtatttagtgactgttcggag
aaaatgatattgaaatctgagaaactcataaggggagaaagaaacttcaagcggggaggacaccattgagttg
gatctggaagcagaattctcagagtctggctcttgatattataggctcttagcgtgttcaactacgattttggc
tctgtcacaaaagagctcccctgtgatcaaggcagtttatggaaactcttttcgaggcagagcatcggctctact
ttctacttcccttatttggaaactttctccagctagatggatagttccgaggcaacgaaagtccaaagcgat
ctgaagattataaaacgatttgccttgatggcctcattcaaaaatgctaaaagagacaagacagcaggaaacagat
gttgagaagctccaggaaagggtactacactaatctcaaggatgcaagtcttttgcggttcttagtcgatatg
cgcggtgttgacattgatgaccggcagctgagggatgacttgatgactatgctaattgctgggtcatgagaca
acagcagcagctacttacttgggctgttttcttctgtcacaaaatcctgaaaaaattaggaaagctcaagct
gagattgatgctgtgcttgggtcaagggtccacccttatgaatcaatgaaaaagctcgagtacatacagctg
atcgtttagaagtccttctgtctcttctcctcagccacctttgctcatcagacgcactctcaaaccagaaaca
ttaccgggtggacacaaaggggaaaaagaaggtcataaagttccaaaagggtgatatcttctatttctgtat
tataatctccatagatctccatacttttgggataatcccacgattttgagcctgagaggtttttaagaaca
aaggagagcaatggaattgaaggatgggctggctttgatccatctcgtagccccggggcactatatccgaat
gagataatagcagactttgcattcttaccatttgggtggaggaccaagaaaatgcattggagaccagtttgca
ctaattggaatcgaccgtcgcactagctatgttgtttcagaaattcgatgtggagctgcgtggaacgccagaa
tctgttgaaactcgtgagcggcgcaacgattcatgcaaaaaatgggatgtggtgcaactaaagagaagatca
aagtga

SEQ ID NO: 54: CYP97B1 and CYP97A2 for *Pisum sativum*:

catcacttaccactaactgaaacttgcaagcaccattctcaacttaacaccgctcgtcaccgccatgggttgc
cgccccctatctcaaccgtcaaacttaccgatgccaattcttcacaccagatttcttctctcttcttctta
caccatccaccctcagctcttccactctctcttcttcttcttcttcttcttcttcttcttcttcttcttct
atcagatgtcaatcgggttaattgggtgaaaagcgaaaacaaagtagtagaaatgtgtttgacaatgctagcaa
cctccttacaagcttgttgaagtgggtgcaaatttaggggtccatgcccatagctgaaggtgccgtcacagatc
tggttgaccggcgctgtttttctcactatatgattgggttcttagagcatgggttctgtgtataaaactggcg
tttggaccgaaagcatttgttgtgtatcagatccattgttgaagacatattctgcgagaaaatgcatt
ttcttatgacaagggagcttctgtgatatcctagaaccaattatgggaaaaggactcatacctgcagacc
ttgagacatggaagcaaaggagaagagtgttgcctcgggtttccatacctcatacttggaaagctatggta
caactattcacttcatgttcagaaagaactgtgttaaagggtcaatgagcttcttgaaggagaggggctga
tggaacagaagtcaattgaattggaccttgaggcagaattttcaaatttgggtcttgagattattgggctag
gtgtgttcaactatgactttgggtctgtcaccaatgaatctcccgttattaaggctgtctatggcactctt
tttgaagccgaacatagatccactttctatattccatattggaaatttccattagcaaggtggattgtgcc
caggcaaaggaagtttcaggatgaccttaaagtcattaatacttgtcttgatggacttatcagaaatgcaa
aagagagcagggcaggaaacagatgttgagaaactgcagcaaaagggttactcaaatttgaaggatgcaagt
cttctgcgtttcttagttgatatgccccgagttgatgttgatgatcgctcagttgagggatgatttaattgac
aatgcttattgtcgtgcatgagacgacggctgcagttcttcatgaggcagttttctgctagctcaaaatc
ctgacaaaatgaagaaggctcaagcagaggttagatttgggtgctggggatggggaagccaacttttgaattg
cttaaaaagtggagtacattagggttaattgttgggtgagactcttcgattatatccacaaccacctctgct
gattagacgttctcactcaaacctgatgttttgcaaggtggacataaagggtgacaaagatgggttatatacattc
ctgctgggactgatgtcttcttcttctgtatatcctcactcagctcctcatttttgggacgcacctaat
gacttcgagcctgaacgatttctagtgcaaaacaataatgaagaagttgaagggtgggttgggtttgaccc
atctcgaagtcctggagccttgtatccaaacgagattatatcagattttgcattcttgccttttgggtggtg
gaccacgaaaatgcgttggagaccaatttgcctcctcatggaatccactgtagcgttagtatgctgctacaga
atttcgatgtggaactgaaggggacccctgaatcggttgaactagttactggggcaactatccataccaaa
aatggattgtgggtgcaatttggaggaagagatctagtttacattgacatgttaactgcaacatttttcttat
gcagaatgatgtacaaaatatttatcattttaaataatgacattaacattgaatagtgtctaatacagctaaag
ggtatttac

Figure 29b

SEQ ID NO: 55: soybean CYP97B2 Glycine:

atgagtgtcgacacttcctccaccctctccaccgtcaccgatgccaatcttcactccagatttcattctcg
tcttggtccattcactcatcatttctcactttctcaacccaaacggatttcttcaatcagatgccaatcaa
ttaataccgataagaagaaatcaagtagaaatctgctgggcaatgcaagtaacctcctcacggacttatta
agtgggtggaagtataggggtctatgcccatagctgaagggtgcagtctcagatctgcttgggtcgacctctctt
tttctcactgtatgattgggttcttgggagcatgggtgcgggtgtataaaacttgcctttggacaaaaagcatttg
ttggtgtatcagatcccatagttgctagacatattctgcgagaaaaatgcattttcttatgacaagggagta
cttgctgatatccttgaaccaataatgggcaaaggactcataccagcagaccttgatacttggagcaaag
gagaagagtcattgctccggctttccataactcatacttggagctatgggtaaaaatattcacaacttggt
cagaaagaacaatattgaagtttaataagcttcttgaaggagaggggttatgatggacctgactcaattgaa
ttggatcttgaggcagagttttctagtttggctcttgatattattgggcttgggtgtgttcaactatgactt
tggttctgtcaccaaagaatctccagttattaaggcagctctatggcactctttttgaagctgaacacagat
ccactttctacattccatatttggaataatccattgggcaagggtggatagtcccaaggcaaagaaagtttcag
gatgacctaaagggtcatcaataacttgtcttgatggacttatcagaaatgcaaaagagagcagacaggaaac
agatgttgagaaattgcagcagagggattacttaaatttgaaggatgcaagtcttctgcgtttcttggttg
atatgcggggagctgatgttgatgatcgtcagttgagggatgatttaatgacaatgcttattgccggtcat
gaaacaacggctgcagttcttacttgggcagttttctcctagctcaaaatcctagcaaaatgaagaaggc
tcaagcagaggttagatttgggtgctgggtacggggaggccaacttttgaatcacttaaggaattgcagtaca
ttagattgattggttgagggtctcttcgtttatacccccaaccacctttgctgatttagacgttccactcaa
tctgatgttttaccaggtgggcacaaagggtgaaaaagatgggttatgcaattcctgctgggactgatgtctt
catttctgtatataatctccatagatctccatatttttgggaccgccctgatgacttcgaaccagagagat
ttcttgtgcaaaacaagaatgaagaaattgaaggatgggctgggtcttgatccatctcgaagtcccggagcc
ttgtatccgaacgaggttatatcggattttgcattcttaccttttgggtggcggaccacgaaaaatgtgttg
ggaccaatttgcctctgatggagtccactgtagegttgactatgctgctccagaattttgacgtggaactaa
aagggaacctgaatcgggtggaactagttactggggcaactattcataccaaaaatggaatgtgggtgcaga
ttgaagaagagatctaatttacgttga

Figure 30

SEQ ID NO: 56: novel cytochrome P450 monooxygenase diatom CYP97B

Skeletonema costatum:

MASYESDLLSTWDEDPSLQKGFDEIEKLRRYFAGLRQTPDGRWVRKSTLFEFLVTNSPSKVVGVPDGER
YESPPKPVNIFDVGVLVGKNTLTWLGFGPNLGMAAVPDAVIQKYEGSFFTFIKGALGGDLQTLAGGPLFLL
LAKYYTDHGPIFNLSFGPKSFLVISDPVMARHILRDSSPEQYCKGMLAEILEPIMGDGLIPADPKIWKVRR
RAVVPGFHKKWLNNSMIGLFGDCGDRLVDDLEKRSTSDKPVIDMEERFCSVTLDIIGKAVFNYDFGSVTKE
PIVKAVYRVLREAHRSSSFIPYWNLPYAEKWMVGQVEFRKDMGMLDDILAKLINRAVETRQEATVEELEE
RETSDDPSLLRFLVDMRGEDLTSKVLRDDLMTMLIAGHETTAAMLWTMFGLVSNDPGMMKEIQAEVRTVM
GNKSRPDYDDVAMKKLRYALIEALRLYPEPPVLIRRARQEDTLPPGGTGLSGGVKVLRGTDIFISTWNLH
RAPEYWENADKYDPTRWERPFKNPGVKGWNGYDPEKQSSQSLYPNEITSDYAFLPFGAGKRKCIGDQFAML
EASVTLSMIMNKFDFTLVGTPEDVGMKTGATIHTMNLNMMVSPRSETNPIPGTNEWWTQHLMRGLSSTG
RPYTSDEDAAWTTSANGMRP

Figure 31

SEQ ID NO: 57: novel cytochrome P450 monooxygenase diatom CYP97B

Skeletonema costatum:

atggcctcctacgagagtgatctgctctcaacatgggatgaagatccatcgctgcaaaaggggtttgactg
ggagattgaaaagctccgtcgggtactttgccggactgcgtcaaacaccagacgggcgatgggtgcgcaagt
cgacactgtttgagtttcttgtgacaaaactctccaagtaaagtagttgggtaggtccggatggggaacgg
tatgaaagccctccgaaaccagtcataatcttcgatgtgggagtgttagtcggtagaataacactcacttg
gttgggatttggaccgaatttgggtatggcgcgggtacccgatgcagtcattcaaaagtatgagggtagct
tcttcacctttatcaagggagcattgggggggtgatttgcaaactttggcgggtgggtcctttgttcttattg
cttgccaagtattatacggatcatggaccattttcaacttgagttttggaccaaaagagctttttgggtgat
ttcggatcctgttatggcgaggcatattttgagggatagttccacggagcagtagttgaaggaatgcttg
cggagattttggaaccgatcatgggtgatggattgattcctgcagatccaaagatttgggaaggttcgtcga
agagctgtcgtacctgggtttccacaaaaagtggtgaacagcatgattgggttggtcggagactgtggtga
tcgtctcgttgacgatctagaaaagcgttctacttcagataaacctgtaattgacatggaagaacgattct
gttcgctcacactcgatatcatcggtgaaggcagtagttcaactatgattttggatcagtgacaaaggaatca
cctattgtaaaggcagtagatacagagtggttacgtgaggcggagcacagatcatcttcgttcacccctactg
gaacttgcttatgctgagaaatggatggttaggacaggttgaattccgcaaagatatgggaatgcttgacg
atatcttggcaaaactgatcaatcgtgctgttgagactaggcaagaagctactgtcgaagagttggaagag
agagaaacaagcgatgatccgagtcctttaagggttcctagttagatagaggggagaagatttaacgagtaa
agtgttgagagatgatttgatgacaatgcttattgcaggacatgaaacaacagcggcaatgctgacgtgga
caatgtttgggctagtaagcaacgatcctggcatgatgaaggaaatccaggcagaagttcgaactgtcatg
ggcaataagtctcgaccagattacgatgatgttggtggcgatgaaaaagttgaggtatgctttgattgaagc
acttcgattatatcccgagccaccctgtgttgattcgcagggcaaggcaagaggacactcttcaccagggtg
gtacgggtctttctggaggtgtcaaagtattgcgtggaacagatatctttatttctacttggaaaccttcac
cgcgctccagaatactgggagaatgcagacaaatatgacctactcgatgggagcgtccgttcaaaaaacc
aggtgttaagggttggaaatggatatgatccggaaaaacaatcatctcaatcactttatcctaacgagataa
cgtcagactatgctttccttcttttgggtgctgggaagagaaaatgtatcggggatcagtttgctatgctc
gaggcttcggttacactatcgatgattatgaataaatttgacttcacgttggtcggtagccctgaagatgt
cggcatgaagaccggagcaactattcataccatgaatgggctcaacatgatggtcagccctcgatcagaga
caaacccgattccagggacaaatgagtggtggacgaaacaacatctaagagaggtttgagttctactgga
agaccatacacttccgatgaagatgcccgcgtggacgacatccgctaattggcatgagaccgtga

Fig. 32

SEQ ID NO: 58: single knockout mutant CYP97A3 *Arabidopsis thaliana*
(SALK_116660):

